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ABSTRACT

Course content guides are provided for the 30 courses in this aviation maintenance technology curriculum approved by the Federal Aviation Administration. Course titles are physics for technicians; aircraft information, regulations, and procedures; aircraft assembly; fundamentals of aircraft electronics; aircraft electrical components; aircraft sheetmetal; aircraft reciprocating engine theory and overhaul; aircraft reciprocating engine and propeller installation and operation; aircraft fuel systems; aircraft turbine engines; aircraft fluid power systems; aircraft electrical systems; aircraft bonded structures; aircraft auxiliary systems; aircraft inspection and troubleshooting; fundamentals of aircraft welding, covering, and finishing; and laboratory courses for all of these courses. Each course content guide consists of these components: a description of the course design (credits, hours, fees), activities, prerequisite knowledge and skills, evaluation, and a course outline. (YLB)

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Course Content Guides

Aviation Maintenance Technology

FAA Approved
Curriculum

University of Alaska
Anchorage

1 October 1987

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Program Chairperson

1985 U.S. Secretary's Award Winner

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PHY 110 PHYSICS FOR TECHNICIANS
90 HOURS

phy110.kw

FAR 147 APPENDIX B (GENERAL)

ITEM	LEVEL	
24	1	Extract roots and raise numbers to a given power.
25	2	Determine areas and volumes of various geometrical shapes.
26	3	Solve ratio proportion and percentage problems.
27	3	Perform Algebraic operations involving-addition, subtraction, multiplication and division of positive and negative numbers.
30	2	Use the principles of simple machines, sound, fluid, and heat dynamics.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Physics 110 is a survey course lightly covering certain useful topics in basic mechanics, thermodynamics, electricity, magnetism, and the structure of matter. Emphasis will be determined by the needs of the vocational areas served, rather than by an intent to provide a balanced overview of physics. The lecture to lab ratio will vary from week to week as the topics dictate. Extreme emphasis will be placed on covering basic ideas in lecture before they are dealt with in individual lab exercises. At the time of this writing Physics 110 is intended primarily to serve the aviation program at ACC and to count toward the two year AAS degree here. It is also expected to apply toward the 4 year degree in aviation to be offered jointly by ACC and APU.

The student is responsible for providing everything personally used in the class. This includes paper, pencils, textbooks, and a basic calculator. These should total less than $75.00.

b. Credits: Students receive 4 credits for successful completion of this course.

c. Hours: The class is scheduled to meet 5 1/2 hours each week for fifteen weeks each semester, for a total of 78 hours when two holidays are accounted for.

d. The lecture/lab ratio will vary from week to week as the topics dictate. Nominally 3 hours each week will be lecture and 3 hours each week will be lab.

e. This course is required for completion of the AMT Associate Program or the AMT certificate program.

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f. This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions in the Aviation Maintenance Field.

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PHY 110 PHYSICS FOR TECHNICIANS

II. ACTIVITIES

The course will run with a traditional lecture format supplemented by selected laboratory exercises. At the time of writing no significant use of packaged computer or audio-visual material is planned. This could change as new material becomes available.

III. PREREQUISITE KNOWLEDGE AND SKILLS

The entering student must be solidly competent in algebra at the Math 55 level. This may be as a result of either high school or college algebra courses. Math beyond this level would be extremely useful to the student, but the actual topics needed will be developed in class. No significant review of Math 55 topics (e.g., basic linear and quadratic equations) can be done in class; the student must enter already competent at these. Also, functional fluency and literacy in American English are required. (English is the language of international aviation, for example. Both for this course and for its primary service area, English is a must. No special class facilities or procedures are available for those who are not native English speakers.) The student is expected to be able to read any introductory physics text used for the course and to write clear lab reports. In addition to academic standards, the student must also satisfy all physical requirements for the appropriate service area. Since this course is not in any way a substitute for traditional introductory courses, it would serve no purpose to accept a student who could not function in one of the industrial programs served.

IV. EVALUATION

Department policy is to assign grades based on a combination of closed book exams, quizzes, and laboratory exercises (quizzes and/or writeups). It is the intent that these be as objective as reasonable possible, but some subjectivity will be present because of lab grading and partial credit on exams and quizzes. Timeliness of completing assignments will definitely affect the grade, as will attendance on certain critical days. Requirements of the service area(s) may force even more stringent attendance policies. The requirements for record keeping and attendance outlined in "Appendix B" will be met.

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PHY 110 PHYSICS FOR TECHNICIANS

V. OUTLINE

- 1.0 Math and Units
  - 1.1 Introduction to Geometry, Trigonometry, and Vectors
  - 1.2 English and Metric Units

- 2.0 Solid Mechanics
  - 2.1 Displacement, Velocity, and Acceleration
  - 2.2 Newton's Laws of Gravity and Motion
  - 2.3 Friction
  - 2.4 Equilibrium
  - 2.5 Work and Energy
  - 2.6 Momentum and Collisions
  - 2.7 Angular Motion

- 3.0 Fluid Mechanics
  - 3.1 Static Pressure
  - 3.2 Fluid Flow

- 4.0 Structure of Matter
  - 4.1 The Bohr Atom
  - 4.2 Crystal Structure

- 5.0 Vibratory Motion
  - 5.1 Hooke's Law for Solids
  - 5.2 Waves

- 6.0 Heat and Temperature
  - 6.1 Temperature Scales
  - 6.2 Heat Transfer
  - 6.3 Unified Gas Law
  - 6.4 Laws of Thermodynamics
  - 6.5 Thermal Expansion

- 7.0 Electricity
  - 7.1 Ohm's Law
  - 7.2 Energy Transfer

- 8.0 Magnetism
  - 8.1 Permanent Magnetism and Compasses
  - 8.2 Electromagnetism

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PHY 110 PHYSICS FOR TECHNICIANS

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

There is only one goal in any true physics class; that is to gain a general understanding of certain topics at a given level. Although this class is geared toward vocational students, it is not designed to teach them their trade as such. Other courses exist to provide them with the specific job skills required. Physics 110 exists to provide a skeleton of scientific knowledge upon which the more specialized courses can build. While a student could learn to do many jobs on a purely rote basis, this would not give the breadth of knowledge that marks the advanced practitioner. The mastery of any profession requires the ability to acquire new information as it becomes available and to integrate it into the body of knowledge already held. Synthesis of separate pieces of information into a greater whole requires the ability to think and a solid framework of basic organization upon which to build. The goal of Physics 110 is to aid in the development of both of these. To this end certain specific outcomes can be identified.

Defined Outcomes:

1.1.1 Learn to define and use the three basic trigonometry functions with simple vector manipulations. Extract roots and raise numbers to a given power. Solve ratio proportion, and percentage manipulations. Perform Algebraic operations involving addition, subtraction, multiplication and division of positive and ntegative numbers.

1.1.2 Memorize and be able to evaluate with specific numbers such common geometrical formulae as the area of a circle, the volume of a cube, etc.

1.2.1 Become familiar with the English and ~~mark~~s metric systems of units.

2.1.1 Demonstrate a solid understanding of the three most common mechanical vectors and be able to work simple dynamical problems involving constant acceleration.

2.2.1 Learn to state and use Newton's three laws of motion both to work simple numerical problems and to analyze possible outcomes of physical situations.

2.2.2 Demonstrate a general understanding of Newton's Law of Gravity.

2.3.1 Know the two physical causes of friction and be able to use these numerically in problems involving solids at low relative speeds.

2.3.2 Understand that the common "laws of friction" cannot be applied randomly to fluids.

2.4.1 Demonstrate understanding of the two conditions of equilibrium by successfully working simple statics problems.

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2.5.1 Distinguish between work, potential energy, and kinetic energy.

2.5.2 Demonstrate an ability to work simple problems by conservation of energy or by "energy accounting".

2.6.1 Define learn momentum as a vector and relate it to linear impulse.

2.6.2 Work very simple problems by conservation of momentum.

PHY 110 PHYSICS FOR TECHNICIANS

2.6.3 Identify the three types of collisions according to elasticity and work problems involving totally inelastic collisions.

2.7.1 Demonstrate the ability to identify the angular equivalents of force, displacement, velocity, acceleration, momemtum, work and energy; and to understand analogies between linear and angular motion.

2.7.2 Demonstrate an understanding of centripetal force and how it relates to Newton's First Law of Motion.

3.1.1 Demonstrate ability to calculate static pressures due to fluids of constant density and to undestand how the general idea can even qualitatively explain atmospheric pressure.

3.1.2 Generally understand Pascal's Principle and its limitations when applied to air or water.

3.2.1 Understand Bernoulli's Principle and how it makes hydraulics possible.

4.1.1 Be able to describe the general structure of the Bohr atomic model.

4.2.1 Know the common states of matter and how solids can be subdivided into various crystalline and noncrystalline classes.

5.1.1 Generally understand the concepts of stress, strain and modulus in the logitudinal case.

5.2.1 Understand the fundamental wave equation.

5.2.2 Demonstrate a general knowledge of resonance.

6.1.1 Be able to define and use the three most common temperature scales.

6.2.1 Know the three methods of heat transfer.

6.3.1 Learn to state and use the Unified Gas Law.

6.4.1 Have an overview of the major concepts fo thermodynamics.

6.5.1 Be able to work simple thermal expansion problems.

7.1.1 Know the formula developed by Ohm to define resistance and demonstrate the ability to "solve" simple D.C. circuits with it.

7.2.1 Demonstrate an understanding of the electric circuit as a device to relocate energy from one region and form to another.

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8.1.1 Be familiar with the simple definition of the magnetic field and how we use a compass to define its direction.

8.2.1 Be aware that magnetism is an offshoot of electricity.

VII PROJECTS

2.1.1 Vector Force Resolution Project

2.3.2 Friction Project

2.7.1 Balance of Torques Project

5.2.2 Sound Resonance Project

6.2.1 Specific Heat Project

6.5.1 Liner Expansion Project

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A T 160 AIRCRAFT INFORMATION REGULATIONS AND PROCEDURES

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FAR 147 APPENDIX B (GENERAL)

ITEM	LEVEL	
11	3	Weigh Aircraft.
12	3	Perform complete weight and balance check and record data.
20	2	Start, ground operate, move, service, and secure aircraft.
21	2	Identify and select fuels.
28	3	Write descriptions of aircraft condition and work performed.
29	3	Complete required maintenance forms, records, and inspection reports.
31	3	Select and use FAA and manufacturers' aircraft maintenance specifications, data sheets, manuals and publications, and related Federal Aviation Regulations.
32	3	Read technical data.
33	3	Exercise mechanic privileges within the limitations prescribed by Part 65 of this chapter.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Beginning with historical background, the student will learn of the government's involvement in aviation maintenance. The student will be familiarized with the policies and procedures of the Aviation Maintenance Technology Program, ACC and the FAA approved program. The student will gain knowledge in maintenance publication, maintenance forms and records, technicians' privileges and limitations, aircraft weight and balance, and aircraft ground operation and fuel servicing.

b. The student will receive 3 credits for successful completion of the course.

c. Hours: The class is scheduled to meet 6 hours per week for 15 weeks each semester (5400 min.) in class. In addition (2700 min.) outside work is expected for total student involvement of (8100 min.).

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d. The 88 hours of instruction accounts for two holidays and is devoted entirely to formal classroom presentations.

e. This course is required for completion of the Associate of Applied Science degree or Certificate program in Aviation Maintenance.

f. Lab Fee: Lab fees for this course are outlined in appendix A.

g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level position in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations will precede preplanned, structured lab exercises that allow the students to observe and practice the tasks necessary to build skill, and self-confidence in reading and interpreting regulations and maintenance data and in performing aircraft weight and balance. Students will also gain the necessary knowledge by performing aircraft ground operations and fuel servicing.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Basic reading and writing skills required.

IV. EVALUATION

a. Class attendance is mandatory. Effects of absences and methods of make up are outlined in Appendix B.

b. Final grades are computed from quizzes, tests reports, lab projects and shop technique.

V. COURSE OUTLINE

1.0 Overview - History of Aviation Maintenance
    1.1 The Federal Government Involvement - 1926 to present
    1.2 The Aviation Act of 1957
    1.3 Aviation Maintenance today and in the future
    1.4 Relationships between aviation maintenance and related fields.

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AT 160 AIRCRAFT INFORMATION REGULATIONS AND PROCEDURES

2.0 Program Orientation
- 2.1 Policies and procedures
  - a. FAA approval
  - b. Attendance
  - c. Building operation
  - d. Aviation community involvement
  - e. AMT students club
- 2.2 Campus education support

3.0 Aviation Maintenance Publications
- 3.1 Federal aviation regulations
- 3.2 Federal publications
  - a. Type certificates
  - b. Inspection aids
  - c. Advisory circulars
- 3.3 Manufacturers' data
- 3.4 Industry standards
- 3.5 Military standards
- 3.6 Vendor data
- 3.7 Airline transportation association (ATA) specification 100 numbering system
- 3.8 ACC aviation library equipment and materials usage
- 3.9 Periodicals and professional associations

4.0 Privileges and Limitations of Aviation Maintenance Technicians
- 4.1 Legal and ethical responsibilities
- 4.2 FAR 65
- 4.3 FAR 43
- 4.4 Classification of aircraft repairs
- 4.5 FAR 145
- 4.6 FAR's 91, 121, 135
- 4.7 Economic considerations

5.0 Maintenance Forms and Records
- 5.1 FAA forms
- 5.2 Pertinent maintenance records
- 5.3 Inspection recording forms
- 5.4 Transfer of ownership maintenance documentation upon transfer of ownership
- 5.5 Maintenance release - return to service
- 5.6 Computerized maintenance records

6.0 Aircraft Weight and Balance
- 6.1 Definition of terms
- 6.2 Weight and balance data
  - a. Manufacturers' data
  - b. Aircraft specifications/type certificate data sheets.
  - c. Aircraft conformity inspection and equipment list
- 6.3 Aircraft preparation for weighing

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- 6.4 Weighing procedures
- 6.5 Weight and balance calculations
- 6.6 Weight and balance extreme conditions
- 6.7 Recording weight and balance data

7.0 Ground Operation and Fuel Servicing
- 7.1 Fuel identification and selection
- 7.2 Start, ground operate, move, fuel service and secure aircraft.

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 Overview

Instructional Goal Know the history of aviation maintenance. Know the federal government's involvement from 1926 to the present time. Know the Aviation Act of 1957 as it relates to aircraft maintenance. Know how the aviation maintenance industry interacts and relates to other career fields.

Defined Outcome The student will know the history of aviation maintenance and have an understanding of what is to be expected in the future. The student will relate to the Aviation Act of 1957 as it pertains to the maintenance of aircraft.

2.0 PROGRAM ORIENTATION

Instructional Goals Know the operation policies and procedures of the Aviation Complex , AMT program and the Anchorage Community College (ACC). Know the building operation and its intended use, tool room operation, clean-up responsibilities, hangar usage and management. Know the purpose and charter of the AMT student club. Know the aviation community's involvement in the AMT program.

Defined Outcome The student will follow the policies and procedures of the Aviation Complex, AMT program and ACC.

Instruction Goal Know the interface between the FAA approval and ACC. Know the approved attendance requirements established in Appendix "B" of the approved curriculum.

Defined Outcome The student will explain and comply with the FAA approved AMT program and the interface between the FAA and ACC. The student will follow the established attendance requirements in appendix "B" of the approved curriculum.

3.0 Aviation Maintenance Publications

Instructional Goal Know the use of FAA and manufacturers' maintenance specifications, type certificate data sheets, manuals and related Federal Aviation Regulations (FAR's).

Defined Outcome The student will locate reference data, use information from manufacturers' manuals, identify and relate regulations governing airworthiness certificates, select and use technical standard orders (TSO's), use reference manuals and other publications. The student will select and use supplementary type certificates and airworthiness directives. Read, understand and relate technical information. The student will have a working knowledge of the FAR's that relate to the maintenance of aircraft and airworthiness standards.

Instructional Goals Know the use of industry and military standards.

Defined Outcome The student will locate, select and use the standards used by industry and military.

Instructional Goal Know the use of Airline Transportation Association (ATA) specification 100 numbering system.

Defined Outcome The student will locate selected maintenance information using specification 100 numbering system.

4.0 PRIVILEGES AND LIMITATIONS OF THE AVIATION MAINTENANCE TECHNICIAN

Instructional Goal Know the legal and ethical responsibilities in the maintenance of aircraft. Know the classification of aircraft repairs.

Defined Outcome The student will interpret the appropriate FAR's in explaining the legal and ethical responsibilities of the technician. FAR's to include Part 65 and the applicable provisions of Parts 43 and 91.

Instructional Goal Know the classification of aircraft repairs.

Defined Outcomes The student will interpret regulations governing repairs and alterations.

Instructional Goal Know the function and operation of repair stations.

Defined Outcome The student will interpret regulations governing repair stations.

5.0 MAINTENANCE FORMS AND RECORDS

Instructional Goal Know the use and function of FAA forms. Know which maintenance documents are necessary for transfer of ownership. Know the use and function of pertinent maintenance records, inspections, recording forms and maintenance releases.

Defined Outcome The student will write descriptions of aircraft condition and work performed. The student will write a description of a major/minor repair and routine maintenance on appropriate FAA forms. The student will make maintenance record entries. The student will prepare and use inspection guides. The student will evaluate aircraft records for compliance with Federal Aviation's Regulations. The student will complete required maintenance forms, records, and inspection reports.

6.0 AIRCRAFT WEIGHT AND BALANCE

Instructional Goal Know weight and balance data as referred to in the manufacturers' data and FAA Aircraft Specifications/Type Certificate Data Sheets. Know the function of an aircraft conformity inspection and equipment list as it relates to the aircraft weight and balance data.

Defined Outcome The student will interpret weight and balance data from the manufacturer and the FAA. The student will refer to the manufacturers' required equipment lists and perform a conformity inspection.

Instructional Goal The student will know aircraft preparation, and procedures for weighing.

Defined Outcome The student will demonstrate preparation of aircraft for weighing and the weighing procedures.

Instructional Goal Know how to locate, interpret and apply weight and balance information. Solve weight and balance problems. Compute the effects of modifications and equipment changes.

Defined Outcome The student will locate, interpret and apply weight and balance information, solving weight and balance problems. The student will compute forward and aft loaded center of gravity problems and compute effect of equipment changes and loading schedules. The student will perform complete weight and balance check and record data.

7.0 GROUND OPERATION AND FUEL SERVICING

Instructional Goal Know aviation fuels identification and selection.

Defined Outcome The student will identify and select aircraft fuels. The student will explain the results of improperly selected fuel as used in aircraft.

Instructional Goal Know aircraft starting procedures, ground operations, fuel servicing and aircraft mooring.

Defined Outcome The student will start and operate aircraft engines, operate aircraft on ground using correct ground communication with airport ground control. The student will prepare for and describe response to an induction fire. The student will direct the movement of aircraft on ground and prepare an aircraft for outside storage.

VII. SHOP PROJECTS

6.0 AIRCRAFT WEIGHT AND BALANCE

Given an aircraft year, make, model, serial number and equipment on board the student will research all necessary data required to perform aircraft weight and balance computation. The student will weigh an aircraft and determine the distance between weigh points. The student will interpret the weight and balance data; make necessary calculations and create a weight and balance report that includes empty weight, empty weight center of gravity and a loading schedule.

7.0 GROUND OPERATION AND FUEL SERVICING

Given fuel samples the student will identify and select the correct fuel used in given make and model aircraft. The student will fuel an aircraft using proper technique including fire precautions and grounding.

The student will start and ground operate a single engine conventional geared aircraft and a multi-engine aircraft communicating with ground control. The student will direct the movement of aircraft on ground and prepare an aircraft for outside storage, to include securing (tie down).

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A T 161 AIRCRAFT ASSEMBLY

at161.kw

FAR 147 APPENDIX B (GENERAL)

Item	Level	
7	2	Use drawings, symbols, and schematic diagrams.
8	3	Draw sketches of repairs and alterations.
9	3	Use blueprint information.
10	3	Use graphs and charts.
17	3	Identify and select aircraft hardware and materials.
22	3	Identify and select cleaning materials.
23	3	Perform aircraft cleaning and corrosion control.

Appendix C (Airframe)

22	1	Rig rotary wing aircraft.
23	2	Rig fixed wing aircraft.
24	2	Check alignment of structures.
25	3	Assemble aircraft.
26	3	Balance and rig movable control surfaces.
27	3	Jack aircraft.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: This course has three major topics: Drawings, Material and Corrosion Control, and Rigging. In drawing, the student will be taught to read blueprints, graphs and charts, and to draw sketches of aircraft repairs. In material and corrosion control the student will select cleaning material after identifying the material to be cleaned. In rigging the student will identify hardware and learn to perform aircraft assembly operations and balance control surfaces.

b. Credits: Students receive 3 credits for successful completion of the course.

c. The course is scheduled to meet 4 hours per week for fifteen weeks each semester. (3600 min.) in class. In addition (4500 min.) outside work is expected for total student involvement of (8100 min.).

d. Lecture: The entire 58 hours of class time accounts for two holidays and is devoted to formal lecture presentation.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

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f. Lab Fees: No lab fees

g. Employment: This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions in the Aviation Maintenance Field.

II. ACTIVITIES

Formal lecture and demonstrations will precede preplanned, structured lab exercises that are presented in the accompanying laboratory courses and allow the students to observe and practice the tasks necessary to build skill and confidence in performing rigging, drawing and cleaning aircraft. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

This course must be taken concurrently with AT 161L.

IV. EVALUATION

a. Class attendance is mandatory. Absence must be made up as provided for in appendix B.

b. Class performance will be evaluated by written and/or oral examinations.

V. OUTLINE

1.0 Drawing History
  1.1 Early Drawing
  1.2 Use of scaled drawings
  1.3 Types of Drawings

2.0 Three View Drawings
  2.1 Practice in finding views
  2.2 Types of lines
  2.3 Drawing objects

3.0 Special Views
  3.1 Cutaways
  3.2 Auxiliary views
  3.3 Broken sections

4.0 Tolerances
  4.1 Fractional
  4.2 Bilateral
  4.3 Unilateral

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A T 161 AIRCRAFT ASSEMBLY

- 5.0 Pictorials
  - 5.1 Cabinet
  - 5.2 Cavalier
  - 5.3 Isometric

- 6.0 Graphs
  - 6.1 Bar graphs
  - 6.2 Line graphs
  - 6.3 Charts

- 7.0 Material Identification
  - 7.1 Metallic
    - a. Type of material
    - b. Alloys
    - c. Process
      - c.1 Forging
      - c.2 Extruding
      - c.3 Casting
      - c.4 Heat treating
      - c.5 Cold working
      - c.6 Stamped
      - c.7 Machined
  - 7.2 Organic
  - 7.3 Plastic
    - a. Thermo plastics
    - b. Thermosetting plastics
  - 7.4 Composite

- 8.0 Cleaning Metals
  - 8.1 Aluminum
  - 8.2 Magnesium
  - 8.3 Ferrous

- 9.0 Corrosion Cleaning
  - 9.1 Chemical
    - a. Caustic
    - b. Acidic
    - c. Wetting agents
      - c.1 Soaps
      - c.2 Detergents
    - d. Solvents
    - e. Dry absorbants
  - 9.2 Mechanical
    - a. Blasting compounds
    - b. Rotary abrasives

- 10.0 Corrosion Protection
  - 10.1 Coating
  - 10.2 Oxides
  - 10.3 Cladding

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A T 161 AIRCRAFT ASSEMBLY

- 11.0 Structures
  - 11.1 Monocoque
  - 11.2 Semimonocoque
  - 11.3 Truss
  - 11.4 Fabrication methods
    - a. Bonded
    - b. Riveted
    - c. Welded
  - 11.5 Braced/cantilever

- 12.0 Hardware
  - 12.1 Safetying
  - 12.2 Selection of fasteners
  - 12.3 Materials charateristics and applicability
  - 12.4 Protective coatings
  - 12.5 Cable systems
    - a. Construction
    - b. Fabrication
    - c. Inspection
    - d. Repair
    - e. Installation

- 13.0 Rigging Helicopters
  - 13.1 Theory of flight
  - 13.2 control functions
  - 13.3 Mechanical mixers (integrators)
  - 13.4 Rigging pins
  - 13.5 Pitch links
  - 13.6 Stick gradiant adjusters
  - 13.7 Artificial force feel

- 14.0 Rigging Fixed Wing Aircraft
  - 14.1 Theory of flight review
  - 14.2 Configurations
  - 14.3 Control functions
  - 14.4 Compound definitions (biplane and monoplane)
  - 14.5 Assembly of components
  - 14.6 Trammeling and measurement
    - a. Propeller protractor
    - b. Plumbs and levels
    - c. Cable tensioner
  - 14.7 Installation of skis and floats

- 15.0 Installation of Control Surfaces
  - 15.1 Cable tension
  - 15.2 Control stops
  - 15.3 Aileron droop

- 16.0 Balance of Control Surfaces
  - 16.1 Flutter dynamics
  - 16.2 Under balance
  - 16.3 Over balance

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A T 161 AIRCRAFT ASSEMBLY

17.0 Flight Test Adjustments
  17.1 Flight trimming
    a. Roll (wing heaviness)
    b. Pitch
    c. Yaw
  17.2 Fixed tabs
  17.3 Washin - Washout
  17.4 Adjustment interaction

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 DRAWING HISTORY

Instructional Goal Know the types of drawings and the benefits and limitations of scaling.

Defined Outcome The student will describe the benefits and limitations of drawings. He will describe the historical use of dimensionless drawings and their current use.

2.0 THREE VIEW DRAWINGS

Instructional Goal Know the placement of views, the types of lines used in orthographic drawing.

Defined Outcome Given a simple object the student will identify the lines necessary to describe it and identify which views are necessary to describe which sides.

3.0 SPECIAL VIEWS

Instructional Goal Know when to use what type of special views to completely describe an object.

Defined Outcome Given a simple object the student will identify the special views necessary to completely describe it.

4.0 TOLERANCES

Instructional Goal Know the use and limitations of tolerances. Be familiar with tolerance "stackup". Interpret tolerances.

Defined Outcome Given tolerances for a drawing the student will determine the total stackup between various places on the drawing and calculate maximum and minimum clearance between mating parts.

5.0 PICTORIALS

Instructional Goal Know the types of pictorial presentations and the inherent distortions of each.

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Defined Outcome Given a pictorial drawing the student will scale the drawing and add such dimensions as to describe it fully.

6.0 GRAPHS

Instructional Goal Know how to read graphs.

Defined Outcome Given a bar graph, line graph, or chart, the student will make accurate third parameter observations.

7.0 MATERIAL IDENTIFICATION

Instructional Goal Know how to identify various materials used in aircraft construction.

Defined Outcome Given various samples of aircraft materials, the student will identify the proper testing procedures for determining the material of the sample.

8.0 CLEANING METALS

Instructional Goal Know how to choose and use cleaning compounds on various materials and the safety precautions associated with each.

Defined Outcome The student will identify the proper cleaning compounds to use on various materials, describe their use and the safety precautions for each.

9.0 CORROSION CLEANING

Instructional Goal Know how to clean corrosion from aircraft parts.

Defined Outcome The students will list the corrosion cleaning methods applicable to various aircraft materials and describe the usage of each.

10.0 CORROSION PROTECTION

Instructional Goal Know the various corrosion protection methods and the appropriate use of each.

Defined Outcome The student will list various corrosion prevention methods and describe the applicable usage of each.

11.0 STRUCTURES

Instructional Goal Know the various methods of construction of aircraft structures and the load paths and fatigue areas in each.

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Defined Outcome Given illustrations of various sample aircraft, the student will identify the type of structure used in each.

12.0 HARDWARE

Instructional Goal Know which hardware items are serviceable in what applications. Know how to install and safety hardware.

Defined Outcome The student will describe selection installation, safetying and removal of hardware in an acceptable manner.

13.0 RIGGING HELICOPTER

Instructional Goal Know the rigging procedure for a typical light helicopter.

Defined Outcome The student will list the steps and tools required in rigging a helicopter and describe the procedure.

14.0 RIGGING FIXED WING AIRCRAFT

Instructional Goal Know the terms, procedures, tools and theory of assembling and rigging fixed wing aircraft.

Defined Outcome The student will describe the assembly and rigging of biplane and monoplane aircraft. He will identify rigging tools and describe their use.

15.0 INSTALLATION OF CONTROL SURFACES

Instructional Goal Know the terms, procedures, tools and theory of assembling and rigging control surfaces.

Defined Outcome The student will describe the assembly and rigging of control surfaces and identify rigging tools and describe their use.

16.0 BALANCE OF CONTROL SURFACES

Instructional Goal Know the causes and consequences of flutter. Know how balance affects flutter.

Defined Outcome The student will describe the courses and consequences of flutter. He will list the steps in balancing control surfaces and describe the procedure and tools used.

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17.0 FLIGHT TEST ADJUSTMENTS

Instructional Goal Know the interactions of flight test adjustments.

Defined Outcome The student will describe the use of adjustments for final flight trimming after assembly. He will identify timing devices and tools and describe the uses of each.

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FAR 147 APPENDIX B (GENERAL)

Item	Level	
7	2	Use drawings, symbols, and schematic diagrams.
8	3	Draw sketches of repairs and alterations.
9	3	Use blueprint information.
10	3	Use graphs and charts.
17	3	Identify and select aircraft hardware and materials.
22	3	Identify and select cleaning materials.
23	3	Perform aircraft cleaning and corrosion control.

Appendix C (Airframe)

22	1	Rig rotary wing aircraft.
23	2	Rig fixed wing aircraft.
24	2	Check alignment of structures.
25	3	Assemble aircraft.
26	3	Balance and rig movable control surfaces.
27	3	Jacking Aircraft.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: This course has three major topics: Drawings, Material and Corrosion Control, and Rigging. In drawing, the student will be taught to read blueprints, graphs and charts, and to draw sketches of aircraft repairs. In material and corrosion control the student will select cleaning material after identifying the material to be cleaned. In rigging the student will identify hardware and learn to perform aircraft assembly operations and balance control surfaces.

b. Credits: Students receive 1 credit for successful completion of the course.

c. Hours: The course is scheduled to meet 4 hours per week for fifteen weeks each semester (3600 min.). Total student involvement of (3600 min.) is expected.

d. Lab: The 60 hours of instruction accounts for two holidays and is devoted entirely to lab exercises.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab Fees: Lab fees for this course are outlined in appendix A.

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g. Employment: This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions in the Aviation Maintenance Field.

II. ACTIVITIES

Formal lab exercises of AT 161L will be coordinated with the formal lecture and demonstrations of AT 161. This allows the students to observe and practice the tasks necessary to build skill and confidence in performing rigging, drawing and cleaning aircraft.

III. PREREQUISITE KNOWLEDGE AND SKILLS

This course must be taken concurrently with AT 161 Aircraft Assembly Lecture.

IV. EVALUATION

a. Class attendance is mandatory. Absence must be made up as provided for in appendix B.

b. Class performance will be evaluated by written practical or oral examinations.

V. OUTLINE

1.0 Drawing History
    1.1 Early drawing
    1.2 Use of scaled drawings
    1.3 Types of Drawings

2.0 Three View Drawings
    2.1 Practice in finding views
    2.2 Types of lines
    2.3 Drawing objects

3.0 Special Views
    3.1 Cutaways
    3.2 Auxiliary views
    3.3 Broken sections
    3.4 Waterlines, buttlines and stations

4.0 Tolerances
    4.1 Fractional
    4.2 Bilateral
    4.3 Unilateral

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- 5.0 Pictorials
  - 5.1 Cabinet
  - 5.2 Cavalier
  - 5.3 Isometric

- 6.0 Graphs
  - 6.1 Bar graphs
  - 6.2 Line graphs
  - 6.3 Charts

- 7.0 Material Identification
  - 7.1 Metallic
    - a. Type of material
    - b. Alloys
    - c. Processes
      - c.1 Forging
      - c.2 Extruding
      - c.3 Casting
      - c.4 Heat treating
      - c.5 Cold working
      - c.6 Stamped
      - c.7 Machined
  - 7.2 Organic
  - 7.3 Plastic
    - a. Thermo plastics
    - b. Thermosetting plastics
  - 7.4 Composite

- 8.0 Cleaning Metals
  - 8.1 Aluminum
  - 8.2 Magnesium
  - 8.3 Ferrous

- 9.0 Corrosion Cleaning
  - 9.1 Chemical
    - a. Caustic
    - b. Acidic
    - c. Wetting agents
      - c.1 Soaps
      - c.2 Detergents
    - d. Solvents
    - e. Dry absorbants
  - 9.2 Mechanical
    - a. Blasting compounds
    - b. Rotary abrasives

- 10.0 Corrosion Protection
  - 10.1 Coating
  - 10.2 Oxides
  - 10.3 Cladding

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- 11.0 Structures
    - 11.1 Monocoque
    - 11.2 Semimonocoque
    - 11.3 Truss
    - 11.4 Fabrication methods
        - a. bonded
        - b. riveted
        - c. welded
    - 11.5 Braced/cantilever

- 12.0 Hardware
    - 12.1 Safetying
    - 12.2 Selection of fasteners
    - 12.3 Materials charateristics and applicability
    - 12.4 Protective coatings
    - 12.5 Cable systems
        - a. Construction
        - b. Fabrication
        - c. Inspection
        - d. Repair
        - e. Installation

- 13.0 Rigging Helicopters
    - 13.1 Theory of flight
    - 13.2 Control functions
    - 13.3 Mechanical mixers (integrators)
    - 13.4 Rigging pins
    - 13.5 Pitch links
    - 13.6 Stick gradiant adjusters
    - 13.7 Artificial force feel

- 14.0 Rigging Fixed Wing Aircraft
    - 14.1 Theory of flight review
    - 14.2 Configurations
    - 14.3 Control functions
    - 14.4 Component definitions (biplane and monoplane)
    - 14.5 Assembly of components
    - 14.6 Trammeling and measurement
        - a. Propeller protractor
        - b. Plumbs and levels
        - c. Cable tensioner
    - 14.7 Installation of skis and floats

- 15.0 Installation of Control Surfaces
    - 15.1 Cable tension
    - 15.2 Control stops
    - 15.3 Aileron droop

- 16.0 Balance of Control Surfaces
    - 16.1 Flutter dynamics
    - 16.2 Under balance
    - 16.3 Over balance

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17.0 Flight Test Adjustments
  17.1 Flight trimming
    a. Roll (wing heaviness)
    b. Pitch
    c. Yaw
  17.2 Fixed tabs
  17.3 Washin - Washout
  17.4 Adjustment interaction

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 DRAWING HISTORY

Instructional Goal Develop skill in selecting appropriate drawing types to convey information.

Defined Outcome The student will choose the correct type of drawing presentation to convey aircraft maintenance information.

2.0 THREE VIEW DRAWINGS

Instructional Goal Develop skill in drawing and interpreting orthographic three view drawings.

Defined Outcome The student will draw small objects orthographically

3.0 SPECIAL VIEWS

Instructional Goal Develop skill in drawing special views.

Defined Outcome The student will draw special views to completely describe an object.

4.0 TOLERANCES

Instructional Goal Develop skill in the use and interpretation of tolerances.

Defined Outcome Given tolerances for a drawing the student will determine the total stackup between various places on the drawing and calculate maximum and minimum clearance between mating parts.

5.0 PICTORIALS

Instructional Goals Draw pictorials from solids or three views.

Defined Outcome The student will draw pictorials from solids or three views.

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6.0 GRAPHS

Instructional Goal Interpret graphs and charts.

Defined Outcomes The student will interpret graphs and charts.

7.0 MATERIAL IDENTIFICATION

Instructional Goal Identify various materials used in aircraft construction.

Defined Outcome Given various pieces of aircraft material, the student will test as appropriate and determine the nature of each.

8.0 CLEANING METALS

Instructional Goal Match cleaning compounds to material and then clean the material.

Defined Outcome The student will match cleaning compounds to material and then clean the material.

9.0 CORROSION CLEANING

Instructional Goal Clean corrosion from aircraft parts.

Defined Outcome The student will clean corrosion from aircraft parts.

10.0 CORROSION PROTECTION

Instructional Goal Know how to use various corrosion protection methods.

Defined Outcomes The student will use various corrosion protection methods as applicable.

11.0 STRUCTURES

Instructional Goal Know the various methods of construction of aircraft structures and the load paths and fatigue areas in each.

Defined Outcome Given various aircraft construction types, the student will identify them.

12.0 HARDWARE

Instructional Goal Select, install and safety fasteners.

Defined Outcome The student will select, install and safety fasteners.

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13.0 RIGGING HELICOPTERS

Instructional Goal Identify the parts of a helicopter.

Defined Outcome Identify those parts of a helicopter which are involved in rigging.

14.0 RIGGING FIXED WING AIRCRAFT

Instructional Goal Assemble and rig a fixed wing aircraft using rigging tools.

Defined Outcome The student will assemble and rig components of a fixed wing aircraft using appropriate rigging tools.

15.0 INSTALLATION OF CONTROL SURFACES

Instructional Goal Install, adjust travel and cable tension on control surfaces.

Defined Outcome The student will install, adjust, travel, and adjust cable on a control surface.

16.0 BALANCE CONTROL SURFACES

Instructional Goal Balance control surfaces.

Defined Outcome The student will balance a control surface.

17.0 FLIGHT TEST ADJUSTMENTS

Instructional Goal Make appropriate adjustments to aircraft surfaces given flight test information.

Defined Outcome The student will make appropriate adjustments to aircraft surfaces given flight test information.

VII. PROJECTS

FAA Level		
3	0.0	Safety.
1	1.0	Projects as available and applicable.
3	2.0	Given six objects, draw them orthographically.
2	3.0	Given an object, draw it orthographically with a special view.
3	4.0	Tolerance orthographic drawings for two mating parts.

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FAA Level

3 5.0 Given six orthographic drawings draw six each of the following:
  a. Cabinet
  b. Cavalier
  c. Isometric

3 6.0 Projects as available or applicable.

3 7.0 Given six metallic objects, identify the material, alloy and process used to generate the shape of each.

3 8.0 Given two objects, clean them using appropriate procedures and safety precautions.

3 9.0 Given three objects, clean corrosion chemically or mechanically as appropriate, using proper procedures and safety precautions.

3 10.0 Given metal parts, student will select and use appropriate corrosion protection methods.

3 11.0 Projects as available and appropriate.

3 12.0 a. Use safety wire, cotter pins, tab washers and locking compounds.
  b. Fabricate, inspect and repair a control cable.

1 13.0 Assist in rigging a helicopter.

2 14.0 Measure and adjust
  a. Incidence
  b. Dihedral
  c. Wash out
  d. Trammeling

3 15.0 Install a control surface.

3 16.0 Balance a control surface.

2 17.0 Projects as available and appropriate.

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FAR 147 Appendix B (General)

Item	Level	
1	1	Measure capacitance and inductance.
2	2	Calculate and measure electrical power.
3	3	Measure voltage, current, resistance, continuity and leakage.
4	3	Determine the relationship of voltage, current and resistance in electrical circuit.
5	3	Read and interpret electrical diagrams.
6	3	Inspect and service batteries.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Beginning with basic electrical concepts, definitions and laws the student will be be taught how to calculate and measure fundamental electrical circuit parameters. The student will be introduced to both passive and reactive electrical components, schematic symbols and how to read electrical wiring diagrams.

b. Credits: The student will receive 4 credits for successful completion of this course.

c. Hours: The class is scheduled to meet 4 hours per week for 15 weeks each semester (3600 min.) in class. In addition (7200 min.) outside work is expected for total student involvement of (10800 min.).

d. The 60 hours of instruction accounts for two holidays and is devoted entirely to formal classroom presentations.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab fees: No lab fees

g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions in the aviation maintenance field.

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II. ACTIVITIES

Formal lecture and demonstrations will precede preplanned, structured lab exercises that are presented in the accompanying laboratory courses and allow the students to observe and practice the tasks necessary to build skill and knowledge level to the required standard.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of math, fractions, decimals, exponents, radicals and algebra upon entering this course. A high school level physics course is also highly recommended. Knowledge may be demonstrated in the following ways:

Completing Math 055 Elementary Algebra with a grade of "C" or better, and/or demonstrating knowledge by exam or academic records.

co-requisite: An understanding of the fundamentals of trigonometry is required in the last half of this course. Students unfamiliar with trigonometry will be required to attend special tutoring which will be coordinated with the Learning Resources Center by the instructor.

IV. EVALUATION

a. Class attendance is mandatory. Effects of students' absences and methods for makeup are outlined in Appendix B.

b. Class performance will be evaluated by written and/or oral quizzes or exams.

V. OUTLINE

1.0 Electrical Energy Basics
  1.1 Work and energy
  1.2 Unit of energy
  1.3 Efficiency
  1.4 Structure of matter
  1.5 Electric charge
  1.6 Valence electrons

2.0 Electric Quantities in Units
  2.1 Charge
  2.2 Unit of charge
  2.3 Current and current carriers

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- 2.4 Unit of current
- 2.5 Voltage
- 2.6 Unit of voltage
- 2.7 Polarity
- 2.8 Sources of voltage
- 2.9 Resistance
- 2.10 Unit of resistance
- 2.11 Conductors, insulators and semiconductors
- 2.12 Power and energy
- 2.13 Unit of power
- 2.14 Efficiency

3.0 Basic Circuit, Laws and Measurement.
- 3.1 Circuit essentials
- 3.2 Symbols and diagrams
- 3.3 Calculating quantities
- 3.4 Measuring quantities

4.0 Introductory Circuit Components
- 4.1 Resistors
- 4.2 Cells and batteries
- 4.3 Lamps
- 4.4 Switches
- 4.5 Circuit protection devices
- 4.6 Wires and cables
- 4.7 Diodes, LED's and zener diodes

5.0 Multiple Load Circuits (using above components as loads)
- 5.1 Using subscripts
- 5.2 Power in multiple load circuits
- 5.3 Series circuits
- 5.4 Conductance
- 5.5 Parallel circuits

6.0 Magnetism and Electromagnetism
- 6.1 Magnetism and magnets
- 6.2 Fields, flux and poles
- 6.3 Electromagnetism
- 6.4 Magnetic materials
- 6.5 MMF, saturation, residual magnetism and reluctance
- 6.6 Magnetic quantities and units
- 6.7 Magnetic circuit components
    - a. Relays and solenoids
    - b. Speakers
    - c. Simple motor
    - d. Simple generator

7.0 Alternating Current
- 7.1 Terminology
- 7.2 Waveforms
- 7.3 Frequency, period and phase

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- 7.4 Defining the sine wave
- 7.5 Simple PM Alternator
- 7.6 Advantages of AC
- 7.7 Three-Phase AC

8.0 Capacitance
- 8.1 Terminology
- 8.2 Capacitor action
- 8.3 Units of capacitance
- 8.4 Measuring capacitance
- 8.5 Types of capacitors and their symbols
- 8.6 Action in DC and AC circuits
- 8.7 Detecting faulty capacitors
- 8.8 Uses of capacitors
- 8.9 Capacitor ratings
- 8.10 Capacitors in series and parallel

9.0 Inductance
- 9.1 Terminology
- 9.2 Inductor action
- 9.3 Units of inductance
- 9.4 Measuring inductance
- 9.5 Types of inductors and their symbols
- 9.6 Action in AC and DC circuits
- 9.7 Detecting faulty inductors
- 9.8 Uses of inductors
- 9.9 Inductor ratings
- 9.10 Inductors in series and parallel

10.0 Transformers
- 10.1 Principles of transformer action
- 10.2 Types of transformers
- 10.3 Transformer ratings
- 10.4 Uses of transformers
- 10.5 Action in AC and DC circuits
- 10.6 Series and parallel windings

11.0 Series-Parallel Circuits
- 11.1 Methods for simplification
- 11.2 Methods for solving circuit problems

12.0 R,L,C Circuits
- 12.1 Impedance
- 12.2 Solving RC circuits
- 12.3 Solving RL circuits
- 12.4 Solving RLC circuits
- 12.5 Resonance
- 12.6 True, apparent and reactive power
- 12.7 Power factor
- 12.8 Phase angle

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13.0 Advance Components
  13.1 Transistors
  13.2 SCR
  13.3 Triac, Diac and UJT's
  13.4 FET transistors
  13.5 Integrated circuits
    a. Linear operational AMPs
    b. Digital gates

14.0 Introduction to Microprocessors
  14.1 Binary number system
  14.2 Series and parallel data transmission
  14.3 Basic system architecture
  14.4 Concept of programing

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 ELECTRICAL POWER BASICS

Instructional Goal Know the relationship between work and energy. Know the forms into which electrical energy can be converted. Know the two forms of electrical energy, dynamic and static.

Defined Outcome The student will define the base unit of electrical energy and list its symbol. The student will explain the forms into which electrical energy can be converted and to list the names of the devices that do the converting. The student will compare and contrast static and dynamic form of electrical energy. The student will label and explain the parts of an atom which relate to electrical energy.

2.0 ELECTRICAL QUANTITIES AND UNITS

Instructional Goal Know the common quantities, base units, symbols and abbreviations used in electrical work. Know how current is carried in various materials. Know sources of voltage. Know how efficiency is calculated. Know how to use scientific notation when performing electrical calculations. Know prefixes used for basic electrical units. Know how to convert the conversion factor between electrical and mechanical power.

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Defined Outcome The student will define: voltage, current, charge, resistance, power and list the quantity, symbol, base unit and abbreviation for each. The student will predict the direction of conventional current flow or electron flow given the polarity of the voltage source. The student will define ion. The student will explain how length, cross-sectional area, type of material and the temperature affect resistance values. The student will calculate the efficiency of an electrical device given its input and output power ratings. The student will convert from one base unit prefix to another.

3.0 BASIC CIRCUITS LAWS AND MEASUREMENTS

Instructional Goal Know the theory of how to measure voltage, current and resistance levels in a circuit. Know schematic symbols for basic circuit elements. Know how to connect symbols to form schematic. Know Ohm's Law and how to use it in calculations. Know the DC power law and how to use it in circuit calculations.

Defined Outcome The student will draw a simple schematic and show how voltage, current and resistance measurements can be made. The student will calculate the levels of voltage, current, resistance and power using Ohm's and the DC Power Laws.

4.0 INTRODUCTORY CIRCUIT COMPONENTS

Instructional Goal Know how cells produce voltage and how cells are connected to form batteries. Know the difference between primary, secondary, dry and wet cells. Know the use of electrolytes and cell ratings. Know how to determine charge level of a battery. Know the difference between Lead Acid and Nickel-Cadmium Batteries. Know the difference between the characteristic of incandescent, neon and LED lamps. Know the characteristics of switches, circuit protection devices, diodes and zener diodes. Know the types of resistors and how to read the color code. Know characteristics of wire and cable.

Defined Outcome The student will explain how to safely charge and determine the state of charge of a Lead Acid and Nicad Battery. The student will draw the symbols for cells, batteries, resistors, switches, lamps, LED's, diodes and Zener Diodes. The student will decode or encode resistance using the standard resistor color code table. The student will define "pole" and "throw" as applied to switches.

Instructional Goal Know how to use subscripts. Know the Kirchoff's Laws for Current and Voltage in series and parallel circuits. Know the power law and resistance laws for series and parallel circuits. Know common circuit faults. Know the concept of voltage rise and voltage drop in multiple load circuits. Know the concept of voltage divider action. Know the conditions required for maximum transfer of power.

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Defined Outcome The student will assign subscripts to loads and sources in multiload circuit. The student will calculate levels of voltage, current, resistance and power in either a series of parallel circuit. The student will identify faults in a circuit. The student will identify a voltage divider circuit and explain its action in terms of voltage drop concepts and Kirchoff's Laws. The student will list the conditions required for maximum power transfer to take place.

6.0 MAGNETISM AND ELECTRONICS

Instructional Goal Know the theory of magnetic fields, flux and magnetic poles. Know the characteristics of electromagnetism and permanent magnetism. Know how to magnetize and demagnetize materials; how to shield devices from a magnetic field. Know how motor and generator action occur and the effects of permeability and saturation. Know the application of magnetic principles to electronic components.

Defined Outcome The student will define: flux, pole, field, reluctance, residual magnetism, permeability, electromagnetism and induction. The student will describe how current is induced into a conductor by a magnetic field. The student will calculate the amp-turns of a coil. The student will identify ferromagnetic materials and predict the direction of flux flow given the polarity of the magnet producing the field. The student will predict the pole polarity of a coil, give its direction of current flow and direction of wind of the coil. The student will explain the "domain" theory of magnetism. The student will explain how a solenoid, pm generator, motor, relay and speaker are constructed.

7.0 ALTERNATING CURRENT

Instructional Goal Know AC terminology. Know common types of AC waveforms. Know the relationship between frequency, cycle, period and phase. Know the various methods of specifying amplitude when measuring a sinewave. Know how the sinewave is produced by induced voltage. Know the advantage of AC current flow. Know the delta and wye methods of wiring 3-phase current. Know how to rectify single and three phase AC currents.

Defined Outcome The student will define: phase, frequency, cycle, amplitude, sinewave. The student will contrast DC, fluctuating DC, pulsating DC and AC. The student will calculate average, RMS, peak, and peak-to-peak voltages given any one of them. The student will predict the motion of a conductor in a magnetic field with a specified current flow using the right-hand rule of induction. The student will draw schematics of 3-phase wye and delta AC systems. The student will draw the output waveform of a single and three phase, one-half wave and full-wave rectifiers.

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8.0 CAPACITANCE

Instructional Goal Know capacitor terminology. Know the units and how to measure capacitance. Know the types of capacitors, their applications and action in AC and DC circuits. Know how to couple capacitors in series and parallel circuits and know how to detect faulty capacitors.

Defined Outcome The student will define the unit of capacitance and explain capacitor action. The student will determine the capacitance value of capacitors wired in series and parallel. The student will contrast the different types of capacitors and list an application for each type. The student will calculate the RC time constant for a resistor-capacitor combination. The student will predict the behavior of a capacitor in both AC and DC circuits. The student will predict the phase relationship between voltage and current in a capacitive circuit.

9.0 INDUCTANCE

Instructional Goal Know the characteristics of Inductance. Know the behavior of inductors in AC and DC circuits. Know the units of inductance and the ratings of inductors. Know the various types of inductors and the applications of inductors in AC and DC circuits. Know Lenz's law and its application to inductors. Know the factors determining inductance. Know the Units of inductance. Know the symbols for inductors and how to prevent undesired inductance. Know the behavior of inductors when placed in series and parallel.

Defined Outcome The student will define: inductance, CEMF, self-inductance, mutual inductance, the Henry, choke and inductive reactance. The student will describe the behavior of an inductor placed in an AC or DC circuit. The student will calculate inductive reactance given the frequency and inductance values of an inductor. The student will predict the phase of the current and voltage in an inductive circuit.

10.0 TRANSFORMERS

Instructional Goal Know the types of transformers and the laws which govern their operation. Know the symbols for various transformers. Know transformer efficiency. Know transformer ratings.

Defined Outcome The student will calculate output voltages and currents given wind ratios. The student will explain transformer losses. The student will identify the transformer type from a schematic symbol. The student will explain the operation of a three phase transformer.

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11.0 SERIES-PARALLEL CIRCUITS

Instructional Goal Know the methods for simplifying series-parallel circuits to one equivalent resistor. Know how the voltage, current, resistance and power levels in each component in a series-parallel circuit.

Defined Outcome The student will calculate voltage, current, resistance and power levels in all components in a series-parallel circuit and reduce the circuit to one equivalent resistance.

12.0 R,L,C CIRCUITS

Instructional Goal Know the concept of impedance. Know the relationship between phase angle, apparent power, true power, power factor, capacitive reactance and inductive reactance. Know the factors producing resonance in an AC circuit. Know how RLC circuits can be used as filters.

Defined Outcome The student will calculate: power factor, phase angle, apparent power, true power and impedance of an RLC circuit given the input voltage and frequency levels. The student will calculate the resonant frequency of an RLC circuit. The student will contrast low pass, high pass and bandpass filters.

13.0 ADVANCED COMPONENTS

Instructional Goal Know the operation of common solid state components. Know how to test them for proper operation. Know how these components behave in AC and DC circuits.

Defined Outcome The student will explain the operation of a PNP and an NPN transistor connected as a solid state switch. The student will explain how a transistor can amplify an AC signal. The student will draw schematic symbols for transistors, SCR's, Triacs, Diacs, OP AMPS and common digital gates. The student will explain the operation of AND gates, OR gates and Inverters. operation of a PNP and an NPN transistor connected as a solid state switch. The student will explain how a transistor can amplify an AC signal. The student will draw schematic symbols for transistors, SCR's, Triacs, Diacs, OP AMPS and common digital gates. The student will explain the operation of AND gates. OR gates and Inverters.

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14.0 INTRODUCTION TO MICROPROCESSORS

Instructional Goal Know the binary number system. Know basic system architecture and the concept of programming.

Defined Outcome The student will count from 1 to 16 in binary and convert back and forth between binary and decimal number system. The student will draw a diagram of a basic microprocessor system and explain its parts. The student will explain how programming runs a microprocessor.

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FAR 147 Appendix B (General)

Item	Level	
1	1	Measure capacitance and inductance.
2	2	Calculate and measure electrical power.
3	3	Measure voltage, current, resistance, continuity and leakage.
4	3	Determine the relationship of voltage, current, and Gesistance in electrical circuits.
5	3	Read and interpret electrical diagrams.
6	3	Inspect and service batteries.

I. COURSE DESIGN

a. Overview: Beginning with basic electrical test equipment, the student will be taught the methods of safe and accurate measurement of electrical quantities. The student will learn to connect, test and operate a variety of basic electrical circuit components. Troubleshooting of defective components will be covered. The student will observe the characteristics of electrical components by wiring them into test circuits by following schematic diagrams.

b. Credits: Students receive 2 credits for successful completion of this course.

c. Hours: The class is scheduled to meet 4 hours per week for 15 weeks each semester (3600 min.) in class. In addition (1800 min.) outside work is expected for total student involvement of (5400 min.).

d. Lecture/Lab: The 56 hours of instruction accounts for two holidays and is devoted entirely to laboratory.

e. This course is required for completion of the Associate of Applied Science degree or Certificate program in Aviation Maintenance.

f. Lab Fees: Lab fees for this course are outlined in Appendix A.

g. Employment: This course, in conjunction with the AMT curriculum, prepares an individual student for entry level positions in the aviation maintenance field.

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II. ACTIVITIES

Formal lecture and demonstrations will precede preplanned, structured laboratory exercises, that lead the student into building the skills necessary to becoming proficient with using basic electronic test equipment to identify faulty circuits and circuits components.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of math, fractions, decimals, exponents, radicals and algebra upon entering this course. A high school level physics course is also highly recommended. Knowledge may be demonstrated in the following ways.

Completing Math 055, Elementary Algebra with grade of "C" or better, and/or demonstrating knowledge by exam or academic record.

Student must have completed or co-register for Fundamentals of Aircraft Electrical components AT 162, or equivalent.

IV. EVALUATION

a. Class attendance is mandatory. Effects of students absences and methods for make-up are outlined in Appendix B.

b. Laboratory performance will be evaluated by observation of student preparation, participation and technique and by written laboratory reports and quizzes.

V. OUTLINE (LECTURE PORTION)

1.0 Introduction to Laboratory Practices
    1.1 Safety practices
    1.2 Care of test equipment
    1.3 Procedures for completing laboratory projects
    1.4 Housekeeping practices

2.0 Using the Multimeter (DVM and analog VOM)
    2.1 Voltmeter setup and operation
    2.2 Ohmeter setup and operation
    2.3 Ammeter setup and operation
    2.4 Reading the meter scales
    2.5 Special functions
    2.6 Replacing fuses

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A T 162L FUNDAMENTALS OF AIRCRAFT ELECTRONICS LAB

3.0 Using the DC power supply
  3.1 Output connections
  3.2 Setting voltage
  3.3 Setting current
  3.4 Reading output on meters
  3.5 Over-voltage protection
  3.6 Safety

4.0 Using the AC, 60 hertz power supply
  4.1 Output connections
  4.2 Setting voltage
  4.3 Setting current
  4.4 Reading output on meters
  4.5 Over-voltage/current protection
  4.6 Safety

5.0 Using the AC, 400 hertz, 3 phase power supply
  5.1 Output connections
  5.2 Setting voltage
  5.3 Setting frequency
  5.4 Reading output
  5.5 Over voltage/current protection
  5.6 Safety

6.0 Using the Oscilloscope
  6.1 Theory of operation
  6.2 Controls
  6.3 Inputs
  6.4 How to read CRT display
  6.5 Safety

7.0 Using the Function generator
  7.1 Theory of operation
  7.2 Controls
  7.3 Input and output terminals
  7.4 Safety

8.0 Connecting Components
  8.1 Soldering
  8.2 Stripping and crimp splices
  8.3 Use of breadboard
  8.4 Clip leads

9.0 Troubleshooting Laboratory Equipment and Component Problems
  9.1 Determine what is normal
  9.2 Check input power
  9.3 Determine test points
  9.4 Select test equipment
  9.5 Take reading
  9.6 Analyze data
  9.7 Confirm fault
  9.8 Repair and/or replace

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A T 162L FUNDAMENTALS OF AIRCRAFT ELECTRONICS LAB

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES (LECTURE PORTION)

1.0 INTRODUCTION TO LABORATORY PRACTICES

Instructional Goal Know laboratory safety practices, care of equipment and cleanup procedures. The student understands the procedure for completing lab projects.

Defined Outcome The student will list the safety practices used while working with electrical circuits. The student will explain how to care for electrical test equipment to prevent damage to the equipment. The student will produce a lab report that conforms to lab manual directives.

2.0 USING THE MULTIMETER

Instructional Goal Know how to set up and accurately read a DVM and VOM. Know how to field service the meter.

Defined Outcome The student will explain how to setup a DVM and VOM to measure voltage, current and resistance. The student will explain how to accurately read the various scales of a DVM and VOM. The student will explain how to replace meter fuses.

3.0 USING THE DC POWER SUPPLY

Instructional Goal Know how to setup a DC power supply to feed a circuit under test and know how to read the output meters. Know how to reset over-voltage protection controls and use the supply safely.

Defined Outcome The student will list setup instructions for a DC power supply including reading of meters and safety precautions.

4.0 USING THE AC, 60 HERTZ POWER SUPPLY

Instructional Goal Know how to setup and operate safely this power supply. Know how to accurately read output levels and to replace fuses.

Defined Outcome The student will list the steps required to safely place in operation the AC, 60 Hertz power supply. The student will explain how to replace fuses when required.

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5.0 USING THE AC, 400 HERTZ, THREE-PHASE POWER SUPPLY

Instructional Goal Know how to safely set up and operate this power supply. Know how to read the output meters and to recognize fault conditions. Know how to connect to a three-phase load.

Defined Outcome The student will explain the proper setup and operation of the power supply. The student will describe how to recognize equipment faults and to connect to three-phase loads. The student will list safety precautions for operation.

6.0 USING THE OSCILLOSCOPE

Instructional Goal Know the theory of operation of oscilloscopes. Understand how to set up, operate, and accurately read the scope. Know safety procedures.

Defined Outcome The student will explain the basic theory of operation of a scope. The student will list steps required to safely place the scope in operation. The student will interpret CRT traces.

7.0 USING THE FUNCTION GENERATOR

Instructional Goal Know the theory of operation of the generator. Know the setup and use of a function generator.

Defined Outcome The student will list setup instructions for placing a function generator in operation. The student will explain the basic theory of operation of the generator.

8.0 CONNECTING COMPONENTS

Instructional Goal Know the theory of soldering electrical connections. Know stripping, crimping and breadboarding procedures.

Defined Outcome The student will list the required tools and procedures required when connecting components by soldering, crimping and breadboarding.

9.0 TROUBLESHOOTING LABORATORY EQUIPMENT AND COMPONENT PROBLEMS

Instructional Goal Know the proper steps to take to isolate electrical problems while using laboratory equipment and components.

Defined Outcome The student will list the steps to be taken when encountering an electrical problem in the laboratory.

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A T 162L FUNDAMENTALS OF AIRCRAFT ELECTRONICS LAB

VII. OUTLINE (LABORATORY/PROJECTS)

FAA Level	
	1.0 Basic DC Measurements
	1.1 Voltage
3	1.2 Current
	1.3 Resistance
	2.0 Basic Circuits
	2.1 Construct series load circuit using resistors
3	2.2 Construct parallel load circuit using resistors
	2.3 Validate use of Ohm's and Kirchoff's laws
	2.4 Validate DC power laws
	2.5 Decode resistor values
	2.6 Find basic circuit faults; short, open
	3.0 Introductory DC Circuit Components
	3.1 Lead-Acid Battery charging and charge measurement
2	3.2 Testing Incandescent, neon and LED lamps
	3.3 Wiring switching circuits with indicator lamps
	3.4 Soldering wire terminations and splices
	3.5 Stripping and crimping wire terminations
	3.6 Testing circuit protection devices
	4.0 Magnetism and Electromagnetism
	4.1 Construct electromagnet and check magnetic polarity
2	4.2 Use iron filings and card to see flux line behavior
	4.3 Wire relay and solenoid switching circuits
	4.4 Operate speaker, motor and simple generator
	5.0 Alternating Current
3	5.1 Measure amplitude and frequency phase using oscilloscope, sinusoidal, square, triangular and saw tooth.
	5.2 Measure amplitude with multimeter
	5.3 Wire three phase load to power supply
	5.4 Construct single and three phase rectifiers
	6.0 Capacitance
	6.1 Construct AC and DC circuits with capacitors
2	6.2 Determine reactance values of capacitors
	6.3 Determine time constant of RC circuit
	6.4 Measure capacitance value of capacitor
	6.5 Measure phase shift in capacitor circuit
	7.0 Inductance
	7.1 Construct AC and DC circuits with inductors
2	7.2 Determine reactance values of inductors
	7.3 Observe CEMF and mutual inductance effects
	7.4 Measure inductance value of inductor
	7.5 Measure phase shift in inductive circuit

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FAA Level	
	8.0 Transformers
	8.1 Measure output voltage of multi wind transformers
2	8.2 Measure efficiency of loaded transformer
	8.3 Construct full-wave and half-wave power supply
	9.0 RLC Circuits
2	9.1 Construct and observe behavior or resonant circuit
	9.2 Phase angle measurement
	10.0 Advanced Components
	10.1 Construct transistor switching circuit
2	10.2 Construct SCR switching circuit
	10.3 Construct Triac Circuit
	10.4 Construct Op Amp circuit
	10.5 Construct digital gate circuits
	10.6 Construct voltage sniffer or magneto checker
	11.0 Introduction to Microprocessors
1	11.1 Input simple program to microprocessor
	11.2 Run program and observe operation

VIII. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES (LABORATORY)

1.0 BASIC DC MEASUREMENTS

Instructional Goal Know DC voltage, current and resistance measurements

Defined Outcome The student will measure voltage, current and resistance given a multimeter, DC power supply and resistive load.

2.0 BASIC CIRCUITS

Instructional Goals Know how to construct series and parallel circuits from schematics. Know the electrical behavior of a circuit under changing voltage and resistance conditions.

Defined Outcome The student will construct series and parallel circuits from schematic drawings. The student will predict the behavior of the circuit knowing the input voltage conditions and the value of the resistance load.

3.0 INTRODUCTORY DC CIRCUIT COMPONENTS

Instructional Goal Know procedure for charging and measuring the charge of a lead acid battery. Know how to solder, strip and crimp splice. Know how to wire lamps and protective device into a circuit.

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Defined Outcome The student will charge a lead acid battery and accurately measure the specific gravity. The student will solder, splice, and crimp a wire termina~~tion.~~l The student will connect lamps and circuit protective devices into a circuit using a schematic.

4.0 MAGNETISM AND ELECTROMAGNETISM

Instructional Goal Know the characteristics of an electromagnet. Know the principles of magnetic device operation.

Defined Outcome The student will construct an operational electromagnet and explain how it operates. The student will predict the polarity of the magnet when given the current direction. The student will connect and operate relays, solenoids, generators and motors given a schematic.

5.0 ALTERNATING CURRENT

Instructional Goal Know how to measure amplitude and frequency of an AC sinewave. Know how to identify AC waveforms. Know how to construct a rectifier and three-phase circuits.

Defined Outcome The student will operate an oscilloscope to measure amplitude and frequency and waveform type of an AC signal. The student will construct a rectifier from a schematic and connect up three-phase loads to a three-phase power supply or generator.

6.0 CAPACITORS

Instructional Goal Know the effect of adding capacitance to a circuit. Know how to connect capacitors in a circuit and test them for correct functioning. Know how to measure capacitance and predict the RC time constant.

Defined Outcomes The student will connect a capacitor in a circuit. The student will test a capacitor for proper functioning and measure its value. The student will construct a circuit with a given RC time constant.

7.0 INDUCTORS

Instructional Goal Know the effect of adding inductance to a circuit. Know how to connect inductors in a circuit and test them for correct functioning. Know how to measure inductance.

Defined Outcome The student will connect an inductor in a circuit. The student will test the inductor for proper functioning and to measure its inductance.

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8.0 TRANSFORMERS

Instructional Goal Know how to connect transformers into circuits. Know how to test transformers. Know how a transformer is used in a power supply.

Defined Outcome The student will connect transformers into circuits given a schematic. The student will test transformers for proper functioning. The student will construct a basic power supply.

9.0 RLC CIRCUITS

Instructional Goal Know the characteristics of a resonant circuit. Know how to measure phase angle.

Defined Outcome The student will construct a resonant circuit and determine its proper functioning. The student will measure phase angle changes.

10.0 ADVANCED COMPONENTS

Instructional Goal Know how to connect and test transistors, SCR's Triac's Op-AMPS and digital gates.

Defined Outcome The student will connect and functionally check a variety of solid state components. Given components and a schematic the student will successfully construct a field test box.

11.0 INTRODUCTION TO MICROPROCESSORS

Instructional Goal Know the procedure required to program a microprocessor

Defined Outcome Given a pre-written program and a microprocessor the student will enter and run a simple program.

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FAR 147 Requirements Appendix B (General)

Item	Level		
5	3		Read and interpret electrical circuit diagrams.
6	3		Inspect and service batteries.
			Appendix C (Airframe)
40	2		Inspect and repair antenna and electronic equipment installations.
48	2		Repair aircraft electrical system components.
49	3		Install, check, and service aircraft electrical wiring controls, switches, indicators and protective devices.
50	3	**	Inspect, check, repair, test and service AC and DC electrical systems.
			Appendix D (Powerplant)
12	2		Repair engine electrical system components.
13	3		Install, check and service engine electrical wiring, controls, switches indicators and protective devices.
17	2		Overhaul magneto and ignition harness.
18	2		Repair engine ignition system components.
19	3		Inspect, check, service, troubleshoot and repair reciprocating and turbine engine ignition systems. (NOTE: turbine engine ignition system taught in AT 262 and AT 262L)

** Troubleshooting taught in AT 267 and 267L.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: This course will identify the following aircraft electrical components, and explain their operation and servicing: DC generator, DC alternator, AC alternator, voltage regulator, reverse current relay, generator and alternator protection devices, magnetos and ignition system components. The student will be taught to troubleshoot, inspect, install and service.

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b. Credits: The student will receive 4 credits for successful completion of this course.

c. Hours: The course is scheduled to meet 6 hours per week for fifteen weeks each semester (5400 min.) in class. In addition (5400 min.) outside work is expected for total student involvement of (10800 min.).

d. The 90 hours instruction accounts for two holidays and is devoted entirely to formal classroom lecture.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance .

f. Lab Fees: There are no lab fees for this course.

g. This course in conjunction with the AMT curriculum prepares an individual for the entry level positions in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations will be used to present the subject along with appropriate media materials. A separate laboratory class will be offered concurrently with this class.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of math, physics, aviation publications and aircraft materials and processes before entering this course. Knowledge may be demonstrated in the following ways: Completion of the following courses with a grade of "C" or better.

A T 160	Aircraft Information, Regulations and Procedures
A T 161	Aircraft Assembly
A T 161L	Aircraft Assembly Lab
A T 162	Fundamentals of Aircraft Electronics
A T 162L	Fundamentals of Aircraft Electronics Lab.
Phys 110	Physics for Technicians

or by demonstrating equivalent knowledge to the instructor's satisfaction by means of written exams, academic record, or work history.

This course must be taken concurrently with AT 163 L.

A T 163 AIRCRAFT ELECTRICAL COMPONENTS

IV. EVALUATION

a. Class attendance is mandatory. Effects of excessive absences and methods for make up are outlined in Appendix B of the FAA approved curriculum.

b. Class performance will be evaluated by written or oral quizzes or exams.

c. Final grades are computed by averaging grades from tests, homework, reports and class participation.

V. COURSE OUTLINE

- 1.0 Review of basic concepts
  - 1.1 DC passive components and circuit laws
  - 1.2 Magnetism and electromagnetism
  - 1.3 Mutual induction
  - 1.4 Principles of AC circuits
  - 1.5 Semiconductor devices
  - 1.6 Aircraft wiring diagram, schematics, component manual and service information

- 2.0 Electrical Power Conversions
  - 2.1 Chemical
    - a. Lead acid theory
    - b. Ni-cad theory
  - 2.2 Mechanical
    - a. AC alternator theory
    - b. DC alternator theory
    - c. DC generator, light current theory
    - d. DC generator, heavy current theory
  - 2.3 Electronic Circuits
    - a. Rectifiers
    - b. Inverters
    - c. Converters

- 3.0 Electrical Power Generation and Supply System Types
  - 3.1 Single DC alternator system and component breakdown
  - 3.2 Multiple DC alternator, unparalled
  - 3.3 Multiple DC alternator, paralled
  - 3.4 Single light current DC generator system and component breakdown
  - 3.5 Multiple light current DC generator
  - 3.6 Single heavy current DC generator
  - 3.7 Multiple heavy current DC generator
  - 3.8 Starter generator system and component breakdown
  - 3.9 Single AC generator
  - 3.10 Multiple AC generator, unparalled
  - 3.11 Multiple AC generator, paralled

A T 163 AIRCRAFT ELECTRICAL COMPONENTS

- 3.12 Battery
- 3.13 External power
- 3.14 Inverter
- 3.15 Variable speed constant frequency alternator systems (VSCF)

- 4.0 Electrical Power Generation Control
  - 4.1 Mechanical
    - a. Vibrator voltage control
      - a.1 Single point
      - a.2 Dual point
    - b. Vibrator output current control
    - c. Reverse current relays
    - d. Constant speed drives
  - 4.2 Solid State
    - a. Transistor voltage regulator
    - b. Zener voltage regulator
    - c. Diode reverse current regulator
    - d. Carbon pile regulator

- 5.0 Electrical Power Generation Protection
  - 5.1 Mechanical
    - a. Overvoltage control relay
    - b. Generator Circuit breakers
      - b.1 Types
      - b.2 Symbols
    - c. Fuses
      - c.1 Types
      - c.2 Symbols
  - 5.2 Solid State
    - a. Generator control units (GCU)
      - a.1 Voltage control
      - a.2 Current control
      - a.3 Phase control
      - a.4 Frequency control

- 6.0 Electrical Power Distribution
  - 6.1 Bus systems
    - a. Essential bus
    - b. Main AC load
    - c. DC load
    - d. Emergency
    - e. External power
    - f. Paralled
    - d. Unparalled
  - 6.2 Bus Control
    - a. Bus power control units
    - b. Bus contactors
  - 6.3 Bus protection
    - a. Bus-tie circuit breakers
    - b. Split-system circuit breaker

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A T 163 AIRCRAFT ELECTRICAL COMPONENTS

- 7.0 Electrical System Loads
  - 7.1 Resistive
    - a. Lights
      - a.1 Post
      - a.2 Flood
      - a.3 Indicator
      - a.4 Warning
      - a.5 Push to test
    - b. Heating elements
    - c. Battery charging
    - d. Current control rheostats
      - d.1 Motor speed
      - d.2 Lamp brilliance
    - e. Current control transistors
      - e.1 Symbols
      - e.2 Types
      - e.3 Failure modes
  - 7.2 Reactive
    - a. Actuators
      - a.1 Symbols
      - a.2 Types
      - a.3 Operational characteristics
    - b. Motors
      - b.1 Symbols
      - b.2 Types
      - b.3 Operational characteristics
      - b.4 Motor controls
        - a. Speed control
        - b. Direction control
        - c. Displacement limits
    - c. Magnetic coils
    - d. Instruments: meter movements, synchros, LCD, LED, CRT, SERVO (DC, AC)
    - e. Avionics

- 8.0 Electrical System Wiring
  - 8.1 Wire design and materials
    - a. Conductor specifications
      - a.1 Core metals
      - a.2 Coatings
      - a.3 Core configurations
    - b. Insulation
      - b.1 Single-layer
      - b.2 Multi-layer
      - b.3 Abrasion resistance
      - b.4 Chemical resistance
      - b.5 Electrical resistance
      - b.6 Dilectric strength
      - b.7 Military specification (MS) system

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A T 163 AIRCRAFT ELECTRICAL COMPONENTS

- 8.2 Wire uses
  - a. Power distribution
  - b. Signal and control
  - c. RF transmission
  - d. Digital transmission
  - e. Bonding
- 8.3 Wire installation
  - a. Support
  - b. Routing
  - c. EMI environment
  - d. Minimum bend radius
- 8.4 Stripping
  - a. Tools
  - b. Insulation removal specifications
  - c. Procedures for various types of insulations
- 8.5 Terminations
  - a. Crimp
  - b. Solder
  - c. Shielded
  - d. Wire wrap
- 8.6 Wire types
  - a. Single-conductor
  - b. Multi-conductor
    - b.1 Straight
    - b.2 Twisted
  - c. Single-conductor shielded
  - d. Multi-conductor shielded
  - e. Bonding jumpers
  - f. Schematic symbols
- 8.7 Soldering
  - a. Tools
  - b. Procedures
  - c. Materials

- 9.0 Connectors
  - 9.1 Types
    - a. Terminal board
    - b. Wire wrap
    - c. Solder
    - d. Quick disconnect
    - e. Rack and inline
    - f. Specs Mil and Arinc
  - 9.2 Installation
    - a. Assembling parts
  - 9.3 Pins
    - a. Crimping
    - b. Inserting and extracting
  - 9.4 Special applications
    - a. Pressure bulkhead
    - b. EMI filtering
    - c. High temperature or vibration
    - d. Fireproof

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- 10.0 Electrical System Switches
  - 10.1 Switch types and symbols
    - a. SPST & SPDT
    - b. DPST & DPDT
    - c. Monetary
    - d. Rotary
    - e. Micro
    - f. Thermal
    - g. Toggle, push button and lever
  - 10.2 Switch ratings
    - a. Current, voltage and power
    - b. Cycles and environmental use
  - 10.3 Switch terminals
    - a. Identification
      - a.1 Screw
      - a.2 Solder
      - a.3 Spade
      - a.4 Pin insert
  - 10.4 Specifications and suppliers
    - a. Aerospace specs
    - b. Identifying suppliers
  - 10.5 Selection
    - a. Derate factor
    - b. Environmental considerations
  - 10.6 Installation
    - a. Up/Foreward - on
    - b. Rotation prevention techniques
    - c. Guards
    - d. Locks
    - e. Micro switch considerations
  - 10.7 Types
    - a. AC/DC
    - b. Toggling
    - c. Rotating
    - d. Latching
  - 10.8 Relay contacts
    - a. Power, voltage and current ratings
    - b. Bounce and hold in force
  - 10.9 Relay coil
    - a. Pull in V/A
    - b. Release V/A
    - c. Hold V/A
    - d. Duty ratings
  - 10.10 Symbols

- 11.0 Switching Circuits
  - 11.1 Master switch system
  - 11.2 Gear position and warning
  - 11.3 Bus selection
  - 11.4 Latching relay

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- 12.0 Electrical System Lights
  - 12.1 Types
    - a. Post, flood, indicator, warning and test
    - b. Florescent
    - c. Neon
    - d. LED's

- 13.0 Fuses and Circuit Breakers
  - 13.1 Types
    - a. Thermal
      - a.1 Fastblow
      - a.2 Slowblow
      - a.3 Trip-free
      - a.4 Element designs and ratings
      - a.5 Case designs
    - b. Magnetic
      - b.1 Element designs
      - b.2 Case designs

- 14.0 High voltage Generation Systems
  - 14.1 Kettering ignition system
    - a. Theory of operation
    - b. Components identification
      - b.1 Ignition coil
      - b.2 Primary points
      - b.3 Distributor
      - b.4 Capacitor
    - c. Applications
    - d. Timing methods
    - e. Starting aids
      - e.1 Retard breaker
      - e.2 Induction vibrator
  - 14.2 Magneto systems
    - a. Types
    - b. Model nomenclature
    - c. Theory of operation
      - c.1 High tension magneto
      - c.2 Low tension magneto
    - d. Components
      - d.1 Rotor
      - d.2 Coil
        - d.2.a Inspection
        - d.2.b Testing
      - d.3 Points and capacitor
        - d.3.a Inspection
        - d.3.b Testing
      - d.4 Distributor
      - d.5 Case

- d.6 Ignition leads
- d.7 Ignition lead transformer
- d.8 Spark plug
  - d.8.a Types
  - d.8.b Heat ranges
  - d.8.c Reach
  - d.8.d Cleaning and gapping
  - d.8.e Rotating cylinder placement
  - d.8.f Testing

e. Applications

f. Timing methods (internal)
- f.1 E-Gap
- f.2 Distributor gear

g. Starting aids
- g.1 Impulse coupling
  - g.1.a Theory of operation
  - g.1.b Components
  - g.1.c Effect when engine timing
- g.2 Induction vibrator
  - g.2.a Theory of operation
  - g.2.b Components

h. Magneto servicing
- h.1 Technical data
- h.2 Disassembly
- h.3 Inspection
- h.4 Assembly
- h.5 Testing

15.0 Servicing Power Generation Components
- 15.1 Batteries
  - a. Lead acid
  - b. Ni-cad
- 15.2 Generators and alternators
  - a. Lubrication
- 15.3 Constant speed drives (CSD)
  - a. Lubrication
- 15.4 Voltage regulators - set voltage level
  - a. Transistor
  - b. Carbon pile
  - c. Mechanical vibrator

V. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 REVIEW OF BASIC CONCEPTS

Instructional Goal Know the fundamental laws that form the foundation for a understanding of how aircraft generation systems operate.

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Defined Outcome The student will describe the basic laws of operation of Basic AC and DC circuits and fundamental circuit components and interpret aircraft wiring diagrams, schematics, components and service information.

2.0 ELECTRICAL POWER CONVERSION

Instructional Goal Understand the theory of operation of chemical, mechanical and electronic devices that are used in electrical power conversions on the aircraft.

Defined Outcome The student will explain the processes whereby chemical and mechanical energy is converted to electrical power. The student will describe the operation of basic electronic circuits that are used for converting AC to DC and DC to AC.

3.0 ELECTRICAL POWER GENERATION SYSTEMS

Instructional Goal Know the theory of operation and the components of the major types of aircraft electrical generation systems.

Defined Outcome The student will list and describe the types of power generation systems used on light and heavy aircraft. The student will explain in detail how each of the systems work, name the required components of each system type, and identify components of selected alternators and generators.

4.0 ELECTRICAL POWER GENERATION CONTROL

Instructional Goal Understand the operation of the control devices that regulate the output of aircraft generation systems.

Defined Outcome The student will match the control devices with the type of generator it controls. The student will explain the theory of operation of each of the types of generator control devices.

5.0 ELECTRICAL POWER GENERATION PROTECTION

Instructional Goal Know the theory of operation and the components required to provide the aircraft generation systems with voltage, current and frequency protection.

Defined Outcome The student will explain the operation of the common devices used to control voltage, current and frequency of aircraft electrical power generation devices. The student will draw the schematic symbols for these devices.

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6.0 ELECTRICAL POWER DISTRIBUTION

Instructional Goal Know the structure of the electrical bus systems used on aircraft. Understand how the bus systems are controlled and protected.

Defined Outcome The student will draw schematics of and explain the operation of the various types of bus systems employed in aircraft systems. The student will explain the operation of bus control devices and bus protection devices.

7.0 ELECTRICAL SYSTEM LOADS

Instructional Goal Understand that the variety of loads placed in the aircraft electrical system can be separated into catagories that require common power requirements from the generation system.

Defined Outcome The student will explain the effects of resistive and reactive loads on the aircraft generation system. The student will describe the types of lamps used as loads. The student will explain how rheostats and transistors are used for current control to the loads.

8.0 ELECTRICAL SYSTEM WIRING

Instructional Goal Know the types, specifications and applications for aircraft wire.

Defined Outcome The student will list the types of wire specified for use on aircraft, select wire appropriate for a specific application, and explain how to properly strip and terminate a wire.

9.0 CONNECTORS

Instructional Goal Understand the types, specifications and applications of connectors used in aircraft electrical systems.

Defined Outcome The student will explain how connectors are selected and assembled for various aircraft applications.

10.0 ELECTRICAL SYSTEM SWITCHES

Instructional Goal Know the criteria for selecting switches for specific circuit applications,. Understand switch derating factors.

Defined Outcome The student will select the appropriate switch given the circuit application. The student will explain how to install a switch.

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11.0 SWITCHING CIRCUITS

Instructional Goal Understand the methods used to switch loads and display indications.

Defined Outcome Given operational requirements and appropriate devices, the student will design a switching circuit which will properly control the operation of the devices.

Instructional Goal Understand the construction and application of relays and solenoids.

Defined Outcome The student will select the appropriate relay or solenoid for a given circuit application. The student will explain the construction details of relays and solenoids and describe the terminal configurations that are commonly used.

12.0 ELECTRICAL SYSTEM LIGHTS

Instructional Goal Understand the operation, construction and application of the range of lights used in aircraft electrical systems.

Defined Outcomes The student will explain how incadescent, flourescent, neon and LED lamps are connected in electrical circuits. The student will explain how to connect these lamps into an electrical circuit.

13.0 FUSES AND CIRCUIT BREAKERS

Instructional Goal Understand the types, construction and application of the range of fuses and breakers available for use in aircraft electrical systems.

Defined Outcome The student will explain how the various types of protection devices function. The student will explain how to select and install a replacement unit.

14.0 HIGH VOLTAGE GENERATION SYSTEMS

Instructional Goal Know the theory of operation and application of the various types of high voltage generation systems found on aircraft. Understand the components required in each system to make it function. Know the procedures for testing and servicing these components.

Defined Outcome The student will check, inspect, install and troubleshoot aircraft magneto and Kettering high voltage systems and system accessories.

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15.0 SERVICING POWER GENERATION COMPONENTS

Instructional Goal Know how to properly service batteries, generators, alternators, CSD's voltage regulators and motors.

Defined Outcome The student will service, remove and install aircraft lead acid and Ni-cad batteries. The student will service generators, alternators, CSD's and motors. The student will adjust system voltage by setting the voltage regulator according to manufacturers' recommendations.

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Charlie Williams
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FAR 147 APPENDIX B (GENERAL)

ITEM	LEVEL		
5	3		Read and interpret Electrical circuit Diagrams.
6	3		Inspect and service batteries.

APPENDIX C (AIRFRAME)

ITEM	LEVEL		
40	2		Inspect and repair antenna and electronic equipment installations.
48	2		Repair aircraft electrical system components.
49	3		Install, check,and service airframe electrical wiring controls, switches, indicators and protective devices. controls, switches, indicators and protective devices.
50	3	**	Inspect, check, repair, test and service AC and DC electrical systems.

APPENDIX D (POWERPLANT)

ITEM	LEVEL		
12	2		Repair engine electrical system components.
13	3		Install, check and service engine electrical wiring, controls, switches, indicators and protective devices.
17	2		Overhaul magneto and ignition harness.
18	2		Repair engine ignition system components.
19	2		Inspect, check, service, troubleshoot and repair reciprocating and turbine engine ignition systems. NOTE: Turbine engine ignition system taught in AT 262 and AT 262L
		**	Troubleshooting taught in AT 267 and 267L.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Provides instruction in inspecting, servicing and checking the following aircraft electrical components: DC generator, DC alternator, AC alternator, voltage regulator, reverse current relay, generator and alternator protection devices, magnetos and ignition system components. The student will be taught to operate and test as well as install and remove these electrical system components.

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b. Credits: The student will receive 3 credits for successful completion of this course.

c. Hours: The course is scheduled to meet 6 hours per week for fifteen weeks each semester (5400 min.) in class. In addition (2700 min.) outside work is expected for total student involvement of (8100 min.).

d. The 86 hours of instruction accounts for two holidays and is devoted entirely to structured lab and shop exercises.

e. This course is required for completion of the Associate of Applied Science degree or Certificate program in Aviation Maintenance.

f. Lab Fees: Lab fees for this course are outlined in Appendix A.

g. This job in conjunction with the AMT curriculum prepares an individual for entry level positions in the aviation maintenance field.

II. ACTIVITIES

Practical laboratory projects will be required of the student to demonstrate his skill in inspecting, checking, servicing, maintaining and troubleshooting electrical components. This course is taken concurrently with AT 163 Aircraft Electrical I.

III. PREREQUISITES KNOWLEDGE AND SKILLS

This laboratory class must be taken concurrently with AT 163. Students must have a working knowledge of math, physics aviation publications and aircraft hardware before entering this course. Knowledge may be demonstrated in the following ways: Passing the following courses with a grade of "C" or better.

A T 160	Aircraft Information, Regulations and Procedures
A T 161	Aircraft Assembly
A T 161L	Aircraft Assembly Lab
A T 162	Fundamentals of Aircraft Electronics
A T 162L	Fundamentals of Aircraft Electronics Lab
PHYS 110	Physics for Technicians

or by demonstrating equivalent knowledge to the instructor's satisfaction by means of written exams, academic record, or work history.
This course must be taken concurrently with AT 163.

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IV. EVALUATION

a. Class attendance is mandatory. Effects of excessive absences and methods for make up are outlined in Appendix B of the FAA approved curriculum.

b. Class performance will be evaluated by written and practical exams.

c. Final grades are computed by averaging grades from tests, homework, reports and class participation.

V. OUTLINE (PROJECTS)

FAA Level	
	1.0 Maintenance of Power Generation Devices
	1.1 Maintain DC alternator
	a. Disassemble
	b. Inspect component parts, mechanical
	c. Electrical checks
	c.1 Diodes
2	c.2 Rotor
	c.3 Stator
	c.4 Filter capacitor
	c.5 Terminals
	d. Assemble
	e. Test run for specification checks
	f. Install on aircraft and test
	1.2 DC Generator - low amperage
	a. Disassemble
	b. Inspect component parts, mechanical
	c. Electrical checks
	c.1 Field coils
2	c.2 Armature
	c.3 Brushes
	c.4 Commutator
	c.5 Terminals
	d. Assemble
	e. Test run for specification checks
	e.1 Flash the field
	e.2 Polarize the generator
	1.3 DC starter-generator
	a. Disassemble
	b. Inspect component parts, mechanical
	c. Electrical checks
	c.1 Field coils
2	c.2 Armature
	c.3 Brushes
	c.4 Commutator
	c.5 Terminals
	d. Assemble
	e. Test run for specfication checks

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FAA Level

- 2.0 Electrical Power Generation Control Installations
  - 2.1 Mechanical 1,2 and 3 unit designs
    - a. Operate regulator with generator/alternator
    - b. Cycle Systems through range of regulatory modes
      - b.1 Test for compliance with manufacturers specs
      - b.2 Simulate malfunctions 2
      - b.3 Practice troubleshooting techniques
  - 2.2 Solid state designs
    - a. Operate regulator with generator/alternator
    - b. Cycle system through range of regulatory modes
      - b.1 Test for compliance with manufacturers specs 2
      - b.2 Simulate malfunctions
      - b.3 Practice troubleshooting techniques

- 3.0 Electrical Power Distribution Systems and Devices
  - 3.1 Troubleshooting techniques
    - a. Normal system operation
    - b. Reading system schematic
    - c. Obtaining system data with test equipment
    - d. Fault analysis 3
    - e. Fault isolation
    - f. Fault correction
    - g. System test for correction verification
  - 3.2 System load and switching maintenance
    - a. Select, install and remove lights
    - b. Select, install and remove rheostats
    - c. Select, install and remove power transistors 3
    - d. Select, install and remove actuators and motors
    - e. Select, install and remove instruments
    - f. Select, install and remove relays and solinoids
    - g. Select, install and remove switches
  - 3.3 System wiring
    - a. Select wire and cable specifications
      - a.1 Single conductor wire
      - a.2 Multi-conductor cable
      - a.3 Shielded cable
      - a.4 Bonding jumpers
    - b. Prepare ends for termination 3
    - c. Select appropriate connector or termination
    - d. Install connectors and terminations
      - d.1 Solder terminations
      - d.2 Crimp terminations
    - e. Install wire and cable
      - e.1 Clamping standards
      - e.2 Splicing standards
      - e.3 Routing practices
      - e.4 Potting

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FAA Level

- 4.0 Batteries
  - 4.1 Lead acid battery
    - a. Remove from aircraft
    - b. Check fluid levels 3
    - c. Check specific gravity
    - d. Complete charge cycle
    - e. Post charge inspection
    - f. Install in aircraft
  - 4.2 Nickel-cadmium battery
    - a. Remove from aircraft 3
    - b. Check fluid levels
    - c. Complete charge cycle
    - d. Post charge inspection
    - e. Install in aircraft

- 5.0 High Voltage Generation Systems
  - 5.1 Ignition system starting aids
    - a. Operate system
    - b. Reading system schematic 2
    - c. Obtaining system data with test equipment
    - d. Fault analysis
    - e. Fault isolation
    - f. Fault correction
    - g. System test for correction verification
  - 5.2 Magneto systems
    - a. Operate system
    - b. Read system schematic 2
    - c. Obtain system data with test equipment
    - d. Perform fault analysis
    - e. Perform fault isolation
    - f. Perform fault correction
    - g. System test for correction verification
      - g.1 Set internal timing (E-Gap)
    - h. Service magneto
      - h.1 Select and check technical data.
      - h.2 Disassemble magneto
      - h.3 Physical inspection
        - a. Case
        - b. Impulse coupling
        - c. Rotor
        - d. Distributor
        - e. Points
      - h.4 Electrical inspection
        - a. Coil
        - b. Capacitor
        - c. Distributor block
      - h.5 Part replacement
      - h.6 Assemble
      - h.7 Test run - check specifications

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FAA Level

- i. Ignition harness
  - 3 i.1 Assemble harness
  - i.2 Test harness
- j. Spark plugs
  - j.1 Remove and replace procedures
  - j.2 Clean
  - 3 j.3 Gap
  - j.4 Test
  - j.5 Plug condition as indicator of engine health
  - j.6 Select correct plug for application

- 6.0 Electric Motors
  - 6.1 DC motors
    - a. Identify
    - 2 b. Inspect
    - c. Service
    - d. Test
  - 6.2 AC motors
    - a. Identify
    - b. Inspect
    - 2 c. Service
    - d. Test
  - 6.3 Motors applications and installation

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 MAINTENANCE OF POWER GENERATION DEVICES

Instructional Goal Know procedures for removal, installation, maintenance, and troubleshooting of aircraft DC alternators, DC Generators and DC Starter Generators.

Defined Outcome The student will remove and replace DC alternators, DC generators and DC starter generators. The student will maintain and troubleshoot the above aircraft components. The student will check power generation devices for proper operation.

2.0 ELECTRICAL POWER GENERATION CONTROL INSTALLATIONS

Instructional Goal Understand the methods of removal, replacement, adjustment and troubleshooting of aircraft power regulation devices.

Defined Outcome The student will remove, install, adjust and troubleshoot mechanical, carbon pile and transistorized regulator devices and systems. The student will test a regulator for proper functioning. The student will select the proper regulator for each aircraft application.

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3.0 ELECTRICAL POWER DISTRIBUTION SYSTEM AND DEVICES

Instructional Goal Understand troubleshooting techniques applied to aircraft power generation systems and devices. Understand removal and replacement of system devices. Know procedures for selecting and preparing wire and cable for installation. Know connection and wire termination installation techniques.

Defined Outcome The student will troubleshoot electrical power distribution systems down to the component level. The student will remove and replace system load and switching devices. The student will select, prepare, connect, terminate and install aircraft electrical wiring and cable. The student will splice aircraft wire and cable.

4.0 BATTERIES

INSTRUCTIONAL GOAL Know the procedures for removal, replacement, charging, testing and installation of aircraft batteries.

Defined Outcome The student will remove, replace, charge and install aircraft batteries. The student will measure specific gravity of lead acid batteries. The student will clean and neutralize electrolyte spills for both lead acid and ni-cad batteries. The student will set up and run ni-cad battery through charge and analysis cycles on commercial reflex charger.

5.0 HIGH VOLTAGE GENERATION SYSTEMS

Instructional Goal Know the procedures for servicing, inspecting, maintain and test magneto and ignition system components.

Defined Outcome The student will service a magneto. The student will clean, select, gap, test and remove and replace spark plugs. The student will disassemble and internally time a magneto.

6.0 ELECTRIC MOTOR

Instructional Goal Know components, operation, servicing and inspection of AC and DC Electric Motors.

Defined Outcome Student will disassemble, inspect, service, resassemble and operate AC and DC motors.

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FAR 147 APPENDIX B (GENERAL)

ITEM	LEVEL	
16	2	Perform basic heat treating processes.

APPENDIX C (AIRFRAME)

10	2	Install special rivets and fasteners.
14	3	Inspect and repair sheet metal structures.
15	3	Install conventional rivets.
16	3	Handform, layout and bend sheetmetal.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a Overview: This course acquaints the student with sheetmetal, its properties and uses in fabrication of structural and nonstructural components of aerospace vehicles. Inspection techniques are addressed along with fabrication and repair processes of bending, cutting, forming, drilling, riveting and heat treating aluminum sheetmetal parts.

b. Credits: Students receive 2 credits for successful. completion of this course.

c. Hours: The courseis schedules to meet 3 hours per week for fifteen weeks each semester (2700 min.) in class. In addition (2700 min.) outside work is expected for total student involvement of (5400 min.).

d. The 43 hours of instruction accounts for two holidays and is devoted entirely to formal classroom presentations.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab fees: There are no lab fees for this course.

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g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations will precede preplanned, structured lab exercises that are presented in the accompanying laboratory course and allow the students to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance functions in inspection, fabrication and repair of sheetmetal structures.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of math. This may be demonstrated in one of the following ways:

a. This class must be taken concurrently with AT 164L.

IV. EVALUATION

a. Class attendance is mandatory. Effects of absences and methods of makeup are outlined in Appendix B.
b. Final grades are computed from written or oral quizzes, tests, reports and class participation

V. OUTLINE

Safety and Shop Practices

1.0 Stresses and Structure
    1.1 Types of sheet metal structure
    1.2 Structural loads
        a. Stresses
            a.1 Tension
            a.2 Compression
            a.3 Bending
            a.4 Torsion
            a.5 Shear

- b. Strength to match the load
- c. Shear strength and bearing strength
- d. Transfer of stresses within a structure

2.0 Materials for Sheetmetal Aircraft Construction
- 2.1 Aluminum alloy
  - a. Advantage over other materials
  - b. Alloying agents and designations
  - c. Heat treatment
  - d. Heat-treatable alloys
    - d.1 Solution heat treatment
    - d.2 Precipitation heat treatment
    - d.3 Annealing
  - e. Temper designation
    - e.1 Heat-treatable alloys
    - e.2 Non-heat-treatable alloys
  - f. Corrosion prevention
    - f.1 Cladding
    - f.2 Oxide film
    - f.3 Paint film
- 2.2 Aluminum alloy-faced honey comb
- 2.3 Magnesium
- 2.4 Stainless steel

3.0 Tools for Sheet Metal Construction and Repair
- 3.1 Layout tools
  - a. Scales
  - b. Combination square
  - c. Dividers
- 3.2 Marking tools
  - a. Scribers
  - b. Lead pencil
- 3.3 Punches
  - a. Prick punch
  - b. Center punch
  - c. Transfer punch
  - d. Pin punch
- 3.4 Cutting Tools
  - a. Shop tools
    - a.1 Squaring shear
    - a.2 Throatless shear
    - a.3 Rotary press
    - a.4 Band saw
    - a.5 Disc and belt sander
    - a.6 Hole saw
    - a.7 Fly cutter
    - a.8 Knock out punches
    - a.9 Files
    - a.10 Nibblers
    - a.11 Rotary file
    - a.12 Chisel

- b. Tools that produce compound curves
  - b.1 Stretch press
  - b.2 Drop hammer
  - b.3 Hydropress
  - b.4 Shrinkers and stretchers
  - b.5 Sand bag
- 3.5 Riveting tools
- 3.6 Special assembly tools
  - a. Clamps and sheet fasteners
    - a.1 Cleco fasteners
    - a.2 Wing nut fasteners
    - a.3 C-clamps
  - b. Hole finder
  - c. Chip chaser

- 4.0 Structural Fasteners
  - 4.1 Solid rivets
    - a. Head shapes
    - b. Alloy types
    - c. Dimensions
    - d. Rivet identification
  - 4.2 Special Fasteners
    - a. Blind rivets
      - a.1 Friction-lock Cherry rivets
      - a.2 Mechanical-lock Cherry rivets
    - b. High-strength pin rivets
    - c. Threaded rivet

- 5.0 Installation of Solid Rivets
  - 5.1 Selection of the proper rivet
  - 5.2 Layout of rows of rivets
    - a. Edge distance
    - b. Pitch
    - c. Gage, or transverse pitch
  - 5.3 Hole preparation of protruding head rivets
    - a. Drill size
    - b. Drilling the hole
    - c. Burring the hole
  - 5.4 Hole Preparation for Flush Rivets
    - a. Countersinking
    - b. Dimpling
      - b.1 Coin dimpling
      - b.2 Radius dimpling
      - b.3 Hot dimpling
    - c. Stacking of sheets for flush riveting
  - 5.5 Rivet Installation
    - a. Hand riveting
    - b. Compression riveting
    - c. Gun riveting
      - c.1 Types of rivet guns
      - c.2 Rivet sets
      - c.3 Bucking bars
      - c.4 Set-up and adjustment of the rivet gun

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- c.5 Driving the rivet
- c.6 Evaluating the rivet
- c.7 N.A.C.A. method of flush riveting
- c.8 Team riveting

- 6.0 Layout and Forming
  - 6.1 Terminology
    - a. Grain of the metal
    - b. Bend radius
    - c. Neutral axis
    - d. Mold line
    - e. Mold point
    - f. Bend tangent line
    - g. Setback
    - h. Flat
    - i. Bend allowance
  - 6.2 Making the layout
  - 6.3 Making the bends
  - 6.4 Folding a box
    - a. Find the setback
    - b. Find the length of the flats for the sides
    - c. Find the length of the flat for the bottom
    - d. Find the bend allowance
    - e. Find the developed length of the material
    - f. Layout the box
    - g. Cut the material
    - h. Bend the box
  - 6.5 Forming compound curves
  - 6.6 Bumping
  - 6.7 Flanging lightening holes
  - 6.8 Joggling

- 7.0 Repair and Assembly of Sheet Metal Structure
  - 7.1 Repairability of sheetmetal structure
    - a. General criteria for repair
      - a.1 Rigidity
      - a.2 Strength
      - a.3 Stress distribution
      - a.4 Fasteners
      - a.5 Corrosion
    - b. Authorization for repairs
  - 7.2 Assessment of damage
  - 7.3 Inspection of riveted joints
  - 7.4 Inspection for corrosion
  - 7.5 Repair of negligible damage
  - 7.6 Repair of stressed-skin structure
    - a. Approval of the repair
    - b. Criteria of a repair
    - c. Replacement of a panel
    - d. Design of a patch for a stressed skin

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- 7.7 Flush patch for a stressed skin
- 7.8 Stringer repair
- 7.9 Waterproof repair for seaplanes
- 7.10 Trailing edge repair
- 7.11 Corrugated skin repair
- 7.12 Inspection openings
- 7.13 Repair to pressurized structure
- 7.14 Specialized repairs
    - a. Gear boxes
    - b. Bolt and rivet repairs
    - c. Balanced surface repair

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 STRESSES AND STRUCTURES

Instructional Goal Understand how stresses are transmitted through structures and how load-bearing structures react to stress. Know the designs of aerospace structures that properly handle the stresses involved.

Defined Outcome The student will define the common stresses in aerospace structures and identify the structures that deal with those stresses, the stress concentration points and stress transfer paths in various locations in the structure.

2.0 MATERIALS FOR SHEETMETAL CONSTRUCTION

Instructional Goal Know the properties of common aircraft structural metals and understand the processes used to change their properties such as heat treatment, alloying, cladding and cold working.

Defined Outcome Students will identify the alloying agents and temper in common aircraft aluminums and describe the properties of those metals.

3.0 TOOLS FOR SHEETMETAL CONSTRUCTION

Instructional Goal To understand and become skilled in the use of sheetmetal tools used for layout, forming, cutting and assembly.

Defined Outcome Students will demonstrate the correct choice and use of selected sheetmetal tools to accomplish a given task.

4.0 FASTENERS

Instructional Goal To understand the uses and limitations and become skilled in the choice and installation of common aerospace fasteners.

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A T 164 AIRCRAFT SHEETMETAL

Defined Outcome Students will demonstrate the correct choice and use of selected sheetmetal and other structural and non-structural fasteners to accomplish a given assignment.

5.0 RIVET INSTALLATION

Instructional Goal Understand and become skilled at all of the tasks necessary to properly install rivets for assembly or repair.

Defined Outcome Students will choose rivets, layouts, installation methods and properly perform all necessary tasks to repair or assemble given projects using aerospace rivets.

6.0 LAYOUT AND FORMING

Instructional Goal Understand and become skilled at all of the tasks necessary to layout and form sheetmetal to given shapes and given dimensions within a reasonable tolerance.

Defined Outcome The student will layout and form simple and complex shapes to given dimensions using breaks, roll formers, shrinkers, stretchers, forming blocks and other available tooling.

7.0 REPAIR AND ASSEMBLY OF SHEETMETAL STRUCTURES

Instructional Goal Understand and become skilled at all the tasks necessary to properly repair a stressed sheetmetal structure or assemble a sheetmetal component to design specifications.

Defined Outcome Students will repair or assemble sheetmetal structures to design specifications, properly choosing materials and fasteners, layout and perform all forming and/or working processes to airworthy standards.

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A T 164L AIRCRAFT SHEETMETAL LABORATORY

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FAR 147 APPENDIX B (GENERAL)

ITEM	LEVEL	
16	2	Perform basic heat treating processes.

APPENDIX C (AIRFRAME)

10	2	Install special rivets and fasteners.
14	3	Inspect and repair sheet metal structures.
15	3	Install conventional rivets.
16	3	Handform, layout and bend sheetmetal.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a Overview: This course acquaints the student with sheetmetal, its properties and uses in fabrication of structural and nonstructural components of aerospace vehicles. Inspection techniques are addressed along with fabrication and repair processes of bending, cutting, forming, drilling, riveting and heat treating aluminum sheetmetal parts.

b. Credits: Students receive 2 credits for successful completion of this course.

c. Hours: The course is scheduled to meet 5 hours per week for fifteen weeks each semester (4500 min.) in class. In addition (900 min.) outside work is expected for total student involvement of (5400 min.).

d. The 75 hours of instruction accounts for two holidays and is devoted entirely to structured lab and shop exercises.

e. This course is required for completion of the Associate of Applied Science degree or Certificate program in Aviation Maintenance.

f. Lab Fees: Lab fees for this course are outlined in appendix A.

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A T 164L AIRCRAFT SHEETMETAL LABORATORY

g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations in the accompanying lecture course precedes preplanned, structured lab exercises that allow the students to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance functions in inspection, fabrication and repair of sheetmetal structures. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of Math. This may be demonstrated in one of the following ways:

a. This class must be taken concurrently with AT 164.

IV. EVALUATION

a. Class attendance is mandatory. Effects of absences and methods of makeup are outlined in Appendix B.

b. Final grades are computed from quizzes, tests reports, lab projects and shop technique.

V. OUTLINE

Safety and Shop Practices

1.0 Stresses and Structure
    1.1 Types of sheet metal structure
    1.2 Structural loads
        a. Stresses
            a.1 Tension
            a.2 Compression
            a.3 Bending
            a.4 Torsion
            a.5 Shear

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- b. Strength to match the load
- c. Shear strength and bearing strength
- d. Transfer of stresses within a structure

2.0 Materials for Sheetmetal Aircraft Construction
- 2.1 Aluminum alloy
  - a. Advantage over other materials
  - b. Alloying agents and designations
  - c. Heat treatment
  - d. Heat-treatable alloys
    - d.1 Solution heat treatment
    - d.2 Precipitation heat treatment
    - d.3 Annealing
  - e. Temper designation
    - e.1 Heat-treatable alloys
    - e.2 Non-heat-treatable alloys
  - f. Corrosion prevention
    - f.1 Cladding
    - f.2 Oxide film
    - f.3 Paint film
- 2.2 Aluminum alloy-faced honey comb
- 2.3 Magnesium
- 2.4 Stainless steel

3.0 Tools for Sheet Metal Construction and Repair
- 3.1 Layout tools
  - a. Scales
  - b. Combination square
  - c. Dividers
- 3.2 Marking tools
  - a. Scribers
  - b. Lead pencil
- 3.3 Punches
  - a. Prick punch
  - b. Center punch
  - c. Transfer punch
  - d. Pin punch
- 3.4 Cutting tools
  - a. Shop tools
    - a.1 Squaring shear
    - a.2 Throatless shear
    - a.3 Rotary press
    - a.4 Band saw
    - a.5 Disc and belt sander
    - a.6 Hole saw
    - a.7 Fly cutter
    - a.8 Knock out punches
    - a.9 Files
    - a.10 Nibblers
    - a.11 Rotary file
    - a.12 Chisel

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b. Tools that produce compound curves
  b.1 Stretch press
  b.2 Drop hammer
  b.3 Hydropress
  b.4 Shrinkers and stretchers
  b.5 Sand bag

3.5 Riveting tools
3.6 Special assembly tools
  a. Clamps and sheet fasteners
    a.1 Cleco fasteners
    a.2 Wing nut fasteners
    a.3 C-clamps
  b. Hole finder
  c. Chip chaser

4.0 Structural Fasteners
  4.1 Solid rivets
    a. Head shapes
    b. Alloy types
    c. Dimensions
    d. Rivet identification
  4.2 Special fasteners
    a. Blind rivets
      a.1 Friction-lock Cherry rivets
      a.2 Mechanical-lock Cherry rivets
    b. High-strength pin rivets
    c. Threaded rivet

5.0 Installation of solid rivets
  5.1 Selection of the proper rivet
  5.2 Layout of rows of rivets
    a. Edge distance
    b. Pitch
    c. Gage, or transverse pitch
  5.3 Hole preparation of protruding head rivets
    a. Drill size
    b. Drilling the hole
    c. Burring the hole
  5.4 Hole preparation for flush rivets
    a. Countersinking
    b. Stacking of sheets for flush riveting
  5.5 Rivet installation
    a. Hand riveting
    b. Compression riveting
    c. Gun riveting
      c.1 Types of rivet guns
      c.2 Rivet sets
      c.3 Bucking bars
      c.4 Set-up and adjustment of the rivet gun
      c.5 Driving the rivet

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- c.6 Evaluating the rivet
- c.7 N.A.C.A. method of flush riveting
- c.8 Team riveting

6.0 Layout and Forming
- 6.1 Terminology
  - a. Grain of the metal
  - b. Bend radius
  - c. Neutral axis
  - d. Mold line
  - e. Mold point
  - f. Bend tangent line
  - g. Setback
  - h. Flat
  - i. Bend allowance
- 6.2 Making the layout
- 6.3 Making the bends
- 6.4 Folding a box
  - a. Find the setback
  - b. Find the length of the flats for the sides
  - c. Find the length of the flat for the bottom
  - d. Find the bend allowance
  - e. Find the developed length of the material
  - f. Layout the box
  - g. Cut the material
  - h. Bend the box
- 6.5 Forming compound curves
- 6.6 Bumping
- 6.7 Flanging lightening holes
- 6.8 Joggling

7.0 Repair and Assemble of Sheet Metal Structure
- 7.1 Repairability of sheetmetal structure
  - a. General criteria for repair
    - a.1 Rigidity
    - a.2 Strength
    - a.3 Stress distribution
    - a.4 Fasteners
    - a.5 Corrosion
  - b. Authorization for repairs
- 7.2 Assessment of damage
- 7.3 Inspection of riveted joints
- 7.4 Inspection for corrosion
- 7.5 Repair of negligible damage
- 7.6 Repair of stressed-skin structure
  - a. Approval of the repair
  - b. Criteria of a repair
  - c. Replacement of a panel
  - d. Design of a patch for a stressed skin
- 7.7 Flush patch for a stressed skin
- 7.8 Stringer repair
- 7.9 Waterproof repair for seaplanes

7.10 Trailing edge repair
7.11 Corrugated skin repair
7.12 Inspection openings
7.13 Repair to pressurized structure
7.14 Specialized repairs
  a. Gear boxes
  b. Bolt and rivet repairs
  c. Balanced surface repair

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 STRESSES AND STRUCTURES

Instructional Goal Understand how stresses are transmitted through structures and how load bearing structures react to stress. Know the designs of aerospace structures that properly handle the stresses involved.

Defined Outcome The student will define the common stresses in aerospace structures and identify the structures that deal with those stresses, the stress concentration points and stress transfer paths in various locations in the structure.

2.0 MATERIALS FOR SHEETMETAL CONSTRUCTION

Instructional Goal Know the properties of common aircraft structural metals and understand the processes used to change their properties such as heat treatment alloying, cladding and cold working.

Defined Outcome Students will identify the alloying agents and temper in common aircraft aluminums and describe the properties of those metals.

3.0 TOOLS FOR SHEETMETAL CONSTRUCTION

Instructional Goal To understand and become skilled in the use of sheetmetal tools used for layout, forming, cutting and assembly.

Defined Outcome Students will demonstrate the correct choice and use of selected sheetmetal tools to accomplish a given task.

4.0 FASTENERS

Instructional Goal To understand the uses and limitations and become skilled in the choice and installation of common aerospace fasteners.

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Defined Outcome Students will demonstrate the correct choice and use of selected sheetmetal and other structural and non-structural fasteners to accomplish a given assignment.

5.0 RIVET INSTALLATION

Instructional Goal Understand and become skilled at all of the tasks necessary to properly install rivets for assembly or repair.

Defined Outcome Students will choose rivets, layouts, installation methods and properly perform all necessary tasks to repair or assemble given projects using aerospace rivets.

6.0 LAYOUT AND FORMING

Instructional Goal Understand and become skilled at all of the tasks necessary to layout and form sheetmetal to given shapes and given dimensions within a reasonable tolerance.

Defined Outcome The student will layout and form simple and complex shapes to given dimensions using breaks, roll formers, shrinkers, stretchers, forming blocks and other available tooling.

7.0 REPAIR AND ASSEMBLY OF SHEETMETAL STRUCTURES

Instructional Goal Understand and become skilled at all the tasks necessary to properly repair a stressed sheetmetal structure or assemble a sheetmetal component to design specifications.

Defined Outcome Students will repair or assemble sheetmetal structures to design specifications, properly choosing materials and fasteners, layout and perform all forming for working processes to airworthy standards.

VII. PROJECTS

0.0 Safety

0.1 Describe which shop operations require personal protection equipment and demonstrate the proper use of that equipment including:

- a. Ear protection
- b. Face mask/eye protection
- c. Gloves
- d. Respirator
- e. Heat protection

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FAA Level

3 0.2 Describe the proper operation and demonstrate the safe use of the following equipment:
  - a. Air powered drill
  - b. Air powered riveter
  - c. Drill press
  - d. Shears: squaring, throatless, hand
  - e. Powered shears and nibblers
  - f. Grinders
  - g. Disk and belt sanders
  - h. Forming roller
  - i. Bending brakes
  - j. Heat treat furnace
  - k. Vertical mill
  - l. Band saw

1 1.0 Stresses and Structures
Identify the major components of a sheetmetal airframe and tell what type of stresses those components experience during given operational conditions.

2 2.0 Materials
Given examples of structural aircraft materials determine their base metal, cladding, approximate temper, heat treatability, weldability and forming properties.

3 3.0 Tools for Sheetmetal
  - 3.1 Identify and demonstrate use of all hand and shop sheetmetal tools provided.
  - 3.2 Create metal project from base metal according to given layout using the required tools and the following processes as needed: shearing, filing, drilling, deburring, nibbling, sawing, notching and sanding.
  - 3.3 Demonstrate care and sharpening of drill bits and chisels.

3 4.0 Structural Fasteners
Identify, describe use of and demonstrate installation of fasteners used in sheetmetal structures such as solid rivets, blind rivets, high strength fasteners (e.g. Hi-lok, huck), bolts and screws.

3 5.0 Installation of Solid Rivets
  - 5.1 Drill, prepare and rivet two sheets of aluminum using protruding head and counter sunk solid rivets in a pattern and manner described in a detailed project sheet.
  - 5.2 Install a flush skin patch according to a project sheet given.

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A T 164L AIRCRAFT SHEETMETAL LABORATORY

FAA Level		
3	6.0	Layout and Forming
	6.1	Bend a given piece of sheetmetal into a channel with the proper radius bends and achieve the required layout dimensions to a tolerance of 1/32 inch.
3	6.2	Splice a sheetmetal channel by riveting an inside channel. Make all necessary calculations and create a layout that achieves original strength of the channel.
3	6.3	Using forming blocks and the type of metal assigned, hand form a sheetmetal part that complies with the specifications in the project sheet. Heat treat the formed part as applicable.
3	6.4	Create a mock instrument panel with at least three hole sizes (0 to 1 inch, 2 to 3 inch, greater than 3 inch) for gauges, switches and lights using a hole saw, fly cutter and knock-out punch.
	7.0	Repair of Sheetmetal Structures
3	7.1	Calculate strength requirements, layout pattern and perform repair for a stressed skin, flush repair.
3	7.2	Install access panel in curved skin according to project design that uses the following techniques: joggling, stretching or shrinking, dimpling, riveting and layout, roll forming, special fastener installation (dzus, cam loc, nutplate, rivnut) and a piano hinge.

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A T 165 AIRCRAFT RECIPROCATING ENGINE THEORY AND OVERHAUL

at165.kw

FAR 147 APPENDIX B (GENERAL)

ITEM	LEVEL	
14	1	Identify and select appropriate nondestructive testing methods.
15	2	Perform penetrant, chemical etching and magnetic particle inspections.
19	3	Perform precision measurements.

APPENDIX D (POWERPLANT)

1	1	Inspect and repair 14-cylinder or larger radial engine.
2	2	Overhaul reciprocating engine.
14	2	Identify and select lubricants
15	2	Repair engine lubrication system components.
16	3	* Inspect, check, service, troubleshoot, and repair engine lubrication systems.
29	2	Repair engine cooling system components.
30	3	* Inspect, check, troubleshoot, service, and repair engine cooling systems.

* Inservice inspection and troubleshooting are contained in AT 267.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Beginning with historical background, the student will be exposed to the theory of operation, the theory of construction and the overhaul practices pertaining to the internal combustion engine. Areas covered include combustion processes, design rationale, cooling, lubrication, disassembly, cleaning, nondestructive testing, measurement and assembly of internal combustion engines.

b. Credits: Students receive 3 credits for successful completion of this course.

c. Hours: The course is scheduled to meet 4 hours per week for fifteen weeks each semester, (3600 min.) in class. In addition (4500 min.) outside work is expected for total student involvement of (8100 min.).

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d. The 58 hours of instruction accounts for two holidays and is devoted entirely to formal classroom presentations.

e. This course is required for completion of the Associate of Applied Science degree or Certificate program in Aviation Maintenance.

f. Lab fees: No lab fees.

g. This course in conjunction with the AMT curriculum prepares an individual for entry level positions in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations will precede preplanned, structured lab exercises that are presented in the accompanying laboratory courses and allow the students to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance functions on internal combustion engines. Field trips may be used to demonstrate heavy aircraft or complex systems that are available at ACC.

III. PREREQUISITES KNOWLEDGE AND SKILLS

Students must have a working knowledge of mathematics, physics, aviation publications and aircraft hardware before entering this course. This working knowledge may be demonstrated in the following ways:

a. Passing the following courses or their equivalent with a grade of "C" or better:

A T	160	Aircraft Information, Regulations and Procedures
A T	161	Aircraft Assembly
A T	161L	Aircraft Assembly Lab
Phys	110	Physics for Technicians

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

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IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for make-up are outlined in Appendix B.

b. Class performance will be evaluated by written and/or oral examinations.

V. OUTLINE

1.0 Powerplant Progress
  1.1 Early engines
  1.2 Present developments
  1.3 Future outlook

2.0 Theory of Operation
  2.1 Fundamentals, four stroke cycle, two stroke cycle, rotary engines (wankel)
  2.2 Boyle's and Charles's laws
  2.3 Power calculations, piston displacement, compression ratio, indicator diagram, indicated horsepower, brake horsepower, power ratings
  2.4 Mechanical efficiency, thermal efficiency, volumetric efficiency
  2.5 Weight, reliability, economy, flexibility, balance
  2.6 Performance factors: manifold pressure, R.P.M., detonation, pre-ignition, mean effective pressure, specific fuel consumption
  2.7 Performance charts

3.0 Theory of Construction
  3.1 Classification by cylinder arrangement and displacement, or number of rotors and displacement
  3.2 Multiple-row radial engines
  3.3 Crankcases: nose section, power section, supercharger section, accessory section
  3.4 Cylinders: barrels, head, finish
  3.5 Piston: types, construction, rings, piston pins, retainers
  3.6 Connecting rods: plain, fork and blade, master and articulated
  3.7 Crankshaft: journals, dynamic dampers, multiple piece
  3.8 Propeller shafts: spline, flange, tapered, extension
  3.9 Bearings: plain, roller, ball
  3.10 Reduction drive assemblies: spur gear, planetary gear, cog belt, v-belt
  3.11 Valve assemblies: sleeve, poppet, rotary, valve seats, valve springs.

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- 3.12 Poppet valve mechanisms: cams, cam rings, followers, lifters, push rods, rockers
- 3.13 Accessory drives: ratio and direction
- 3.14 Wankel engine construction: rotor, rotor shaft, rotor housing, end plates

4.0 Cooling
- 4.1 Air cooling: repair of pressure air cooling systems, including baffles, fins, cowling, augmentor and cowflaps
- 4.2 Liquid cooling: design and maintenance of liquid cooling systems.

5.0 Lubricants
- 5.1 Lubricant classification: animal, vegetable, mineral, semi-synthetic, synthetic
- 5.2 Mineral lubricants: solid, semi-solid, liquid
- 5.3 Oil properties: gravity, flash point, viscosity, pour point, extreme pressure, stability
- 5.4 Oil functions: cooling, cleaning, lubrication, sealing, corrosion protection, cushion and hydraulic fluid
- 5.5 Greases: numbers, dropping point, types, additives, aircraft requirements
- 5.6 Special lubricants: thread lubricant, spark plug lubricant, rust-preventive compound.

6.0 Lubrication Systems
- 6.1 Pressure, splash and combination lubricant systems
- 6.2 Components: tanks, plumbing, temperature regulator, viscosity valve, pressure relief, filters, oil separator, gauges, pumps, dilution system
- 6.3 Maintenance

7.0 Overhaul Practices
- 7.1 Reasons for overhaul:
- 7.2 Types for overhaul:
- 7.3 Overhaul shop: organization, certification
- 7.4 Tools and equipment: shop equipment (manufacturers' manuals, bulletins, Airworthiness Directives (AD's), Type Certificate Data Sheets.
- 7.5 Overhaul publication
  - a. Government publications
    - a.1 FAR's
      - a. Major, minor repairs
      - b. Major, minor alterations
    - a.2 Type Certificate Data
    - a.3 Advisory Circular
    - a.4 Airworthiness Directives'

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- b. Manufacturers' publications
    - b.1 Overhaul manual
    - b.2 Parts manual
    - b.3 Service information
    - b.4 Operator's manual
- 7.6 Engine receiving: preliminary inspection, records
- 7.7 Cleaning: degreasing, disassembly, stripping, blasting
- 7.8 Inspection: visual, nondestructive testing and dimensional.
- 7.9 Cylinder overhaul: head, barrel, studs, skirt, flange, seats, guides
- 7.10 Valves: grinding, testing springs
- 7.11 Crankshafts: alignment, passages
- 7.12 Camshafts: inspection and runout
- 7.13 Connecting rods: twist, bushing replacement, bearings
- 7.14 Crankcase: heli-coil, studs, gears
- 7.15 Assembly: safety, approved methods, assembly technique, proper use of fasteners and torque valves
- 7.16 Engine operation
    - a. Operating precautions
    - b. Power settings and adjustments
    - c. Cruise control: range and speed, power settings
    - d. Starting and stopping
- 7.17 Approving for return to service

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 POWERPLANT PROGRESS

Instructional Goal Know the developmental history of powerplants. Identify historical trends of present day engine design and construction, and extrapolate probable future developments.

Defined Outcome Student will describe the history of powerplants, the trends of present day engine design and construction. The student will tell of historical trends and possible future developments.

2.0 THEORY OF OPERATION

Instructional Goal Know the factors of design that effect powerplant output and suitability.

Defined Outcome The student will describe how each design factor effects powerplant output and suitability. He will predict (calculate) output, compression pressure and fuel consumption.

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A T 165 AIRCRAFT RECIPROCATING ENGINE THEORY AND OVERHAUL

3.0 THEORY OF CONSTRUCTION

Instructional Goal Know the rationale of construction of the various engine components and parts.

Defined Outcome The student will describe the rationale of construction of the various engine components and parts.

4.0 COOLING

Instructional Goal Know the testing and repair techniques for air cooling systems and the design and maintenance of liquid cooling systems.

Defined Outcome The student will describe the testing and repair techniques used on air cooling systems and the design and maintenance of liquid cooling systems.

5.0 LUBRICANTS

Instructional Goal Know the classifications of lubricants, their function and the proper application for each kind.

Defined Outcome Given an engine lubrication need, the student will select the proper lubricant characteristics and compatibility, and describe the effects of use of improper lubricants.

6.0 LUBRICATION SYSTEMS

Instructional Goal Know the operation, testing and repair of lubrication systems.

Defined Outcome The student will describe the operation, testing and repair of lubrication systems.

7.0 OVERHAUL PRACTICES

Instructional Goal Know what constitutes a proper overhaul and/or rebuilding.

Defined Outcome The student will describe the overhaul/rebuilding process for an engine and its component parts.

Instructional Goal Know engine starting and stopping procedures, operating precautions and cruise control settings.

Defined Outcome The student will describe starting, operating and stopping an engine. Proper operating precautions will be included in the description.

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A T 165L AIRCRAFT RECIPROCATING ENGINES THEORY AND OVERHAUL LAB

at165lab.kw

FAR 147 APPENDIX B (GENERAL)

ITEM	LEVEL		
14	1		Identify and select appropriate nondestructive testing methods.
15	2		Perform penetrant, chemical etching and magnetic particle inspections.
19	3		Perform precision measurements.

APPENDIX D (POWERPLANT)

1	1		Inspect and repair 14-cylinder or larger radial engine.
2	2		Overhaul reciprocating engine.
14	2		Identify and select lubricants
15	2		Repair engine lubrication system components.
16	3	*	Inspect, check, service, troubleshoot, and repair engine lubrication systems.
29	2		Repair engine cooling system components.
30	3	*	Inspect, check, troubleshoot, service, and repair engine cooling systems.

* Inservice inspection and troubleshooting are contained in AT 267.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Beginning with historical background, the student will be exposed to the theory of operation, the theory of construction and the overhaul practices pertaining to the internal combustion engine. Areas covered include combustion processes, design rationale, cooling, lubrication, disassembly, cleaning, nondestructive testing, measurement and assembly of internal combustion engines.

b. Credits: Students receive 3 credits for successful completion of this course.

c. Hours: The course is scheduled to meet 6 hours per week for fifteen weeks each semester, (5400 min.) in class. In addition (3300 min.) outside work is expected for total student involvement of (8700 min.).

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A T 165L AIRCRAFT RECIPROCATING ENGINES THEORY AND OVERHAUL LAB

d. The 87 hours of instruction accounts for two holidays and is devoted entirely to laboratory and shop exercises.

e. This course is required for completion of the Associate of Applied Science degree or Certificate program in Aviation Maintenance.

f. Lab fees: Lab fees for this course are outlined in Appendix A.

g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations in the accompanying lecture course precede preplanned, structures lab exercises that allow the students to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance functions on internal combustion engines. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITES KNOWLEDGE AND SKILLS

Students must have a working knowledge of math, physics, aviation publications, and aircraft hardware before entering this course. This working knowledge may be demonstrated in the following ways:

a. Passing the following courses or their equivalent with a grade of "C" or better:

A T 160	Aircraft Information, Regulations and Procedures
A T 161	Aircraft Assembly
A T 161L	Aircraft Assembly Lab
PHYS 110	Physics for Technicians

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

c. This course must be preceded by or taken concurrently with AT 165.

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A T 165L AIRCRAFT RECIPROCATING ENGINES THEORY AND OVERHAUL LAB

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for make-up are outlined in Appendix B.

b. Class performance will be evaluated by written and/or oral examinations.

V. OUTLINE

1.0 Powerplant Progress:
  1.1 Early engines.
  1.2 Present developments.
  1.3 Future outlook.

2.0 Theory of Operation:
  2.1 Fundamentals, four-stroke cycle, two-stroke cycle, rotary engines (wankel).
  2.2 Boyle's and Charles's laws.
  2.3 Power calculations, piston displacement, compression ratio, indicator diagram, indicated horsepower, brake horsepower, power ratings.
  2.4 Mechanical efficiency, thermal efficiency, volumetric efficiency.
  2.5 Weight, reliability, economy, flexibility, balance.
  2.6 Performance factors: manifold pressure, R.P.M., detonation, pre-ignition, mean effective pressure, specific fuel consumption.
  2.7 Performance charts.

3.0 Theory of Construction:
  3.1 Classification by cylinder arrangement and displacement, or number of rotors and displacement.
  3.2 Multiple-row radial engines.
  3.3 Crankcases: nose section, power section, supercharger section, accessory section.
  3.4 Cylinders: barrels, head, finish.
  3.5 Piston: types, construction, rings, piston pins, retainers.
  3.6 Connecting rods: plain, fork and blade, master and articulated.
  3.7 Crankshaft: journals, dynamic dampers, multiple piece
  3.8 Propeller shafts: spline, flange, tapered, extension.
  3.9 Bearings: plain, roller, ball.
  3.10 Reduction drive assemblies: spur gear, planetary gear, cog belt, v-belt.
  3.11 Valve assemblies: sleeve, poppet, rotary, valve seats, valve springs.

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- 3.12 Poppet valve mechanisms: cams, cam rings, followers, lifters, push rods, rockers.
- 3.13 Accessory drives: ratio and direction.
- 3.14 Wankel engine construction: rotor, rotor shaft, rotor housing, end plates.

4.0 Cooling
- 4.1 Air cooling: repair of pressure air cooling systems, including baffles, fins, cowling, augmentor and cowlflaps.
- 4.2 Liquid cooling: design and maintenance of liquid cooling systems.

5.0 Lubricants:
- 5.1 Lubricant classification: animal, vegetable, mineral, semi-synthetic, synthetic.
- 5.2 Mineral lubricants: solid, semi-solid, liquid.
- 5.3 Oil properties: gravity, flash point, viscosity, pour point, extreme pressure, stability.
- 5.4 Oil functions: cooling, cleaning, lubrication, sealing, corrosion protection, cushion and hydraulic fluid.
- 5.5 Greases: numbers, dropping point, types, additives, aircraft requirements.
- 5.6 Special lubricants: thread lubricant, spark plug lubricant, rust-preventive compound.

6.0 Lubrication Systems:
- 6.1 Pressure, splash and combination lubricant systems.
- 6.2 Components: tanks, plumbing, temperature regulator, viscosity valve, pressure relief, filters, oil separator, gauges, pumps, dilution system.
- 6.3 Maintenance.

7.0 Overhaul Practices:
- 7.1 Shop and equipment safety:
  - a. General shop environment.
  - b. Mechanical hazards.
  - c. Electrical hazards.
  - d. Chemical hazards.
- 7.2 Preparation of work station for overhaul:
  - a. Engine hoist and slings.
  - b. Overhaul stands.
  - c. Storage facilities.
  - d. Parts protection.
- 7.3 Tool and equipment familiarization:
  - a. Engine cleaning laboratory:
    - a.1 Solvent tanks.
    - a.2 Decarbonizing tank.
    - a.3 Bead blaster.
    - a.4 Permanent steam cleaner.

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b. Non-destructive test laboratory:
  b.1 Magnaflux.
  b.2 Zyglo.
  b.3 Dye check.
  b.4 X-ray.
  b.5 Eddy current.
  b.6 Ultrasonic.

c. Overhaul laboratory:
  c.1 Valve reconditioning equipment.
  c.2 Cylinder reconditioning equipment.
  c.3 Drill press.
  c.4 Hydraulic press.

7.4 Overhaul data:
The student will locate appropriate reference and overhaul data for a specific engine. Information will include the following:
a. Manufacturers' overhaul manuals.
b. Type certificate data sheet.
c. Service letters and bulletins.
d. Airworthiness directives.
e. Illustrated parts catalogue.
f. Table of limits.

7.5 Perform a receiving inspection: The student will perform a receiving inspection on an assigned engine. The inspection will include a general description of the condition of the engine and a detailed description and inventory of accessories and components installed on the engine when it was accepted. The student will inspect permanent forms and records for completeness.

7.6 Disassemble a reciprocating engine: Using the appropriate reference materials the student will dissassemble a reciprocating engine following the sequence recommended by the manufacturer. Removed components will be identified by use of stamped metal tags or other appropriately approved marking methods, stored and protected to prevent damage.

7.7 Cleaning operations:
The student will select and use the appropriate cleaning process for various engine components.
a. Chemical cleaning processes.
b. Mechanical cleaning processes.
c. Protection of components during cleaning operations.

7.8 Inspection process:
The student will select and use the appropriate inspection processes, equipment and tools to assertain the condition of the following engine components: Crankcase, sumps, crankshaft, camshaft, cylinder, connecting rods, pistons, oil pumps, accessory case.
a. Physical inspection: use physical senses to check for obvious flaws and defects.

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- b. Non destructive inspection:
    - b.1 Magnaflux.
    - b.2 Dye penetrant.
        - a. High contrast
        - b. Ultraviolet sensitive.
- c. Dimensional inspection to determine structural integrity and fits and clearances.
    - c.1 Outside micrometer.
    - c.2 Inside micrometer.
    - c.3 Depth gauges.
    - c.4 Telescoping gauges.
    - c.5 Small hole gauges.
    - c.6 Dial indicator.
    - c.7 "Jo" blocks.
    - c.8 "V" blocks.

7.9 Repair-recondition--service components.
- a. Reprofile broke cylinder fins.
- b. Hone a cylinder wall.
- c. Recondition a valve.
- d. Recondition a valve seat.
- e. Remove a damaged stud.
- f. Install a standard oversized stud.
- g. Install a helicoil.
- h. Install piston, rings and cylinder on crankcase.

7.10 Reassemble a reciprocating engine: The student will reassemble an assigned engine in accordance with the procedures outlined in the technical data, close attention will be given to proper torquing and safetying methods.

7.11 Recordkeeping: The student will complete the required forms, records, and documents to demonstrate return-to service of the overhauled engine.

8.0 Engine Operation

8.1 Start an aircraft engine and while observing proper operating precautions, make power settings, adjust for cruise and shutdown.

8.2 Describe and demonstrate proper break-in procedures for overhauled engines equipped with steel and chrome cylinders.

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 POWERPLANT PROGRESS

Instructional Goal Know the developmental history of powerplants. Identify historical trends of present day engine design and construction, and extrapolate probable future developments.

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Defined Outcome Student will describe the history of powerplants, the trends of present day engine design and construction. The student will tell of historical trends and possible future developments.

2.0 THEORY OF OPERATION

Instructional Goal Know the factors of design that effect powerplant output and suitability.

Defined Outcome The student will describe how each design factor effects powerplant output and suitability. He will predict (calculate) output, compression pressure and fuel consumption.

3.0 THEORY OF CONSTRUCTION

Instructional Goal Know the rationale of construction of the various engine components and parts.

Defined Outcome The student will describe the rationale of construction of the various engine components and parts.

4.0 COOLING

Instructional Goal Know the testing and repair techniques for air cooling systems and the design and maintenance of liquid cooling systems.

Defined Outcome The student will describe the testing and repair techniques used on air cooling systems and the design and maintenance of liquid cooling systems.

5.0 LUBRICANTS

Instructional Goal Know the classifications of lubricants, their function and the proper application for each kind.

Defined Outcome Given an engine lubrication need, the student will select the proper lubricant characteristics and compatibility, and describe the effects of use of improper lubricants.

6.0 LUBRICATION SYSTEMS

Instructional Goal Know the operation, testing and repair of lubrication systems.

Defined Outcome The student will describe the operation, testing and repair of lubrication systems.

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7.0 OVERHAUL PRACTICES

Instructional Goal Know what constitutes a proper overhaul and/or rebuilding.

Defined Outcome The student will describe the overhaul/rebuilding process for an engine and its component parts.

Instructional Goal Know and become skilled at practices, processes, and procedures necessary to overhaul a reciprocating engine.

Defined Outcome The student will disassemble, clean, inspect, perform selected services and reassemble a reciprocating engine:

8.0 ENGINE OPERATION

Instructional Goal Know engine starting and stopping procedures, operating precautions and cruise control settings.

Defined Outcome The student will perform: a) installation in test cell, b) installation on an airframe, c) installation on portable run stand. The student will start and operate an engine observing safety precautions and noting performance parameters.

VII. PROJECTS OUTLINE

FAA Level

1.0 Powerplant Progress

1 1.1 Using cutaways and mockups, identify early trends in engine construction.

1.2 Comparing early engines with contemporary engines, extrapolate on possible future developments.

2.0 Theory of Operation

1 2.1 Examine four-stroke cycle, two-stroke cycle and Wankel mock-ups and cutaways. Determine when each event of the cycle begins and ends as the output shaft turns.

3.0 Theory of Construction

2 3.1 Following the manufacturer's manual, disassemble an aircraft engine and identify its major and minor assemblies and parts by name, function, material and fabrication methods.

4.0 Cooling

3 4.1 Repair a pressure air cooling systems, cowling, baffels and fins by replacement of chafe strips and seals and stop drilling of cracks.

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A T 165L AIRCRAFT RECIPROCATING ENGINES THEORY AND OVERHAUL LAB

FAA LEVEL

5.0 Lubricants
- 5.1 From samples, identify various aircraft lubricants.
- 3 5.2 Using manufacturers' data, apply the proper lubricant to lubricate powerplant assemblies.

6.0 Lubrication Systems
- 6.1 Repair lubrication system components
- 3 6.2 Check lubrication system operation
- 6.3 Change oil, check screens and filters

7.0 Overhaul Practices
- 7.1 Using pertinent data, perform overhaul functions on engine parts and components.
- 3 7.2 Explain and describe the advantages and limitations of dye penetrant, flourescent type dye penetrant, chemical etching, and magnetic particle inspection processes.
- 7.3 Perform a dye penetrant inspection of ferrous and non-ferrous engine components -- to include, but not be limited to -- engine crank case, oil sump, accessory cover, cylinder and pistons.
- 7.4 Perform magnetic partical inspection of ferrous engine components -- to include, but not limited to -- engine crank shaft, cam shaft, connecting rod, accessory gear and crank case through bolts.
- 7.5 Use appropriate inspection tools to detect wear or deterioration in engine components - to include but not be limited to -- crank shaft bearing surfaces, cam shaft bearing surfaces pistons, piston pins, connecting rods and cylinders.
- 7.6 Using pertainent data, assemble an aircraft engine.
- 7.7 Assemble required records as would be done during an overhaul and fabricate a proper return to service statement.

8.0 Engine Operation
- 2 8.1 Start an aircraft engine and while observing proper operating precautions, make power settings, adjust for cruise and shutdown.

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FAA Level

5.0 Lubricants
- 5.1 From samples, identify various aircraft lubricants.
- 3 5.2 Using manufacturers' data, apply the proper lubricant to lubricate powerplant assemblies.

6.0 Lubrication Systems
- 3 6.1 Repair lubrication system components
- 6.2 Check lubrication system operation
- 6.3 Change oil, check screens and filters

7.0 Overhaul Practices
- 3 7.1 Using pertinent data, perform overhaul functions on engine parts and components.
- 7.2 Using pertainent data, assemble an aircraft engine.
- 7.3 Assemble required records as would be done during an overhaul and fabricate a proper return to service statement.

8.0 Engine Operation
- 2 8.1 Start an aircraft engine and while observing proper operating precautions, make power settings, adjust for cruise and shutdown.

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A T 260 AIRCRAFT RECIPROCATING ENGINE AND PROPELLER INSTALLATION AND OPERATION
45 HOURS

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FAR 147 APPENDIX D (POWERPLANT)

ITEM	LEVEL	
1	1	Inspect and repair 14-cylinder or larger radial engine.
3	3	Inspect, check, service, and repair opposed and radial engines and reciprocating engine installations.
4	3	Install, troubleshoot, and remove reciprocating engines.
8	3	Perform powerplant conformity and airworthiness inspections.
9	2	Troubleshoot, service, and repair fluid rate-of-flow indicating systems.
10	3	Inspect, check, service, troubleshoot, and repair engine temperature, pressure, and r.p.m. indicating systems.
11	3	Inspect, check, service, troubleshoot, and repair engine fire detection and extinguishing systems.
14	2	Identify and select lubricants.
15	2	Repair engine lubrication system components.
16	3	Inspect, check, service, troubleshoot, and repair engine lubrication systems.
17	2	Overhaul magneto and ignition harness.
18	2	Repair engine ignition system components.
19	3	Inspect, check, service, troubleshoot, and repair reciprocating and turbine engine ignition systems.
29	2	Repair engine cooling system components.
30	3	Inspect, check, troubleshoot, service, and repair engine cooling systems.
31	2	Repair engine exhaust system components.
32	3	Inspect, check, troubleshoot, service, and repair engine exhaust system.
33	1	Inspect, check, service, and repair propeller synchronizing and ice control systems.
34	2	Identify and select propeller lubricants.
35	2	Balance propellers
36	2	Repair propeller control system components.
37	3	Inspect, check, service and repair fixed-pitch, constant-speed, and feathering propellers, and propeller governing systems.
38	3	Install, troubleshoot, and remove propellers.

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A T 260 AIRCRAFT RECIPROCATING ENGINE AND PROPELLER INSTALLATION AND OPERATION

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Students enrolled in this course will become proficient in the installation, preparation, performance testing and troubleshooting of aircraft reciprocating engines.

b. Credits: Students will receive 2 credits for successful completion of this course.

C. Hours: The course is scheduled to meet 3 hours per week for fifteen weeks each semester (2700 min). In addition 2700 min of outside work is expected for a total student involvement of 5400 minutes.

d. The 45 hours of instruction accounts for two holidays and is devoted entirely to formal classroom presentations.

e. This course is required for completion of the Associate of Applied Science degree or Certificate program in Aviation Maintenance.

f. Lab Fees: No lab fees

g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level position in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations will precede preplanned, structured lab exercises that are presented in the accompanying laboratory courses and allow the students to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance on aircraft reciprocating engines and propeller installation and operation. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of mathematics, physics, aviation publications, aircraft hardware, reciprocating engines, powerplant and electrical systems. This working knowledge may be demonstrated in the following ways:

A T 260 AIRCRAFT RECIPROCATING ENGINE AND PROPELLER INSTALLATION AND OPERATION

A T	160	Aircraft Information, Regulations and Procedures
A T	161	Aircraft Assembly
A T	161L	Aircraft Assembly Lab
A T	163	Aircraft Electrical Components
A T	163L	Aircraft Electrical Components Lab
A T	165	Aircraft Reciprocating Engine Theory and Overhaul
A T	165L	Aircraft Reciprocating Engine Theory and Overhaul Lab
PHYS	110	Physics for Technicians

b. Demonstrating equivalent knowledge to the instructors' satisfaction by means of oral or written exam, academic record or work history.

c. Must be taken concurrently with AT 260L, Aircraft Reciprocating Engine and Propeller Installation and Operation Lab.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for make-up are outlined in Appendix B.

b. Class performance is evaluated by written or oral quizzes or tests and class participation.

V. OUTLINE

1.0 Aircraft Engine Assembly
  1.1 Ignition system
  1.2 Induction system
  1.3 Fuel system
  1.4 Engine cooling and cowling system

2.0 Propeller Theory and FAR's
  2.1 Nomenclature of propeller components
  2.2 Theory of operation
  2.3 Propeller FAR's

3.0 Fixed Pitch Propellers
  3.1 Wood propellers and components
  3.2 Metal propellers and components
  3.3 Fixed pitch propeller installation
  3.4 Tracking and balancing
  3.5 Remove and replace propellers

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4.0 Ground Adjustable and Automatic Propellers
  4.1 Ground adjustable propellers
  4.2 Automatic propellers
  4.3 Two-position propellers
  4.4 Propeller removal and replace

5.0 Constant Speed Propellers and Governors
  5.1 System operation
  5.2 Components
  5.3 Manufacturers
  5.4 Inspection and servicing
  5.5 Blade-to-hub assembly
  5.6 Remove and replace propeller and governor

6.0 Feathering and Reversing Propellers
  6.1 Feathering operation and manufacturers
  6.2 Feathering system and components
  6.3 Reversing operation and manufacturers
  6.4 Reversing system and components

7.0 Propeller Auxiliary Systems
  7.1 Synchronization systems
  7.2 Automatic feathering

8.0 Installation of Aircraft Engine on Airframe
  8.1 Prepare engine for installation
  8.2 Prepare airframe for engine
  8.3 Hoisting methods

9.0 Preparation of Engine for Operational Check.
  9.1 Instruments
  9.2 Engine controls
  9.3 Test equipment
  9.4 Pre-oiling
  9.5 Fuel servicing
  9.6 Propeller installation

10.0 Preparation of Airframe for Operation
  10.1 Instruments
  10.2 Airframe controls
  10.3 Fuel servicing

11.0 Starting and Operation of Aircraft Engine
  11.1 Start procedures
  11.2 Operation procedures
  11.3 Troubleshoot

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12.0 Recording Operational Data
- 12.1 Methods
- 12.2 Data sheets
- 12.3 Engine instruments and indications
  - a. RPM
  - b. Manifold pressure
  - c. Fuel flow
  - d. EGT
  - e. Cylinder head temperature
  - f. Oil pressure
  - g. Oil temperature
  - h. Fuel pressure
- 12.4 Charting engine performance
- 12.5 Engine/propeller critical ranges
- 12.6 Documenting results

13.0 Engine Components Check
- 13.1 Cylinder compression
- 13.2 Ignition system
  - a. Magneto-to-engine timing
  - b. Operation of starting aids
- 13.3 Induction and fuel system
- 13.4 Cooling system
- 13.5 Propeller
- 13.6 Instrument accuracy and calibration
  - a. Track
  - b. Manifold pressure
  - c. Fuel flow
  - d. EGT
  - e. Cylinder head temperature
  - f. Oil pressure
  - g. Oil temperature
  - h. Fuel pressure

14.0 Final Engine Operation Adjustment
- 14.1 Engine oil pressure
- 14.2 Fuel pump pressure
- 14.3 Cylinder head temperature
- 14.4 Engine oil temperature
- 14.5 Engine power
- 14.6 Carburetor heat control
- 14.7 Propeller governor
- 14.8 Idle speed and mixture
- 14.9 Engine control cushion and stops
- 14.10 Basic operational sequence

15.0 Aircraft Engine Airworthiness and Log books
- 15.1 Engine components check
- 15.2 Logbooks and aircraft/engine records
- 15.3 FAR's
- 15.4 Airworthiness directives
- 15.5 Manufacturers' service publications
- 15.6 Operations Manual

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A T 260 AIRCRAFT RECIPROCATING ENGINE AND PROPELLER INSTALLATION AND OPERATION

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 AIRCRAFT ENGINE ASSEMBLY

Instructional Goal Know the primary sub-systems of an aircraft reciprocating engine and their importance to the operation of an engine.

Defined Outcome The students will assemble the ignition, induction and fuel systems to a reciprocating engine in an airworthy manner

2.0 PROPELLER THEORY AND FAR'S

Instructional Goal Know the theory of operation of an aircraft propeller, its components, and FAR's.

Defined Outcome Students will identify all the parts of an aircraft propeller, the theory of operation and explain propeller Federal Aviation Regulations.

3.0 FIXED PITCH PROPELLERS

Instructional Goal Know the primary components of a wood and metal fixed pitch prop, installation and tracking procedures.

Defined Outcome Students will identify components of wood and metal propellers and will demonstrate on their project engine how to install and track a propeller.

4.0 GROUND ADJUSTABLE AND AUTOMATIC PROPS

Instructional Goal Know the history and applications of ground adjustable, automatic and two position propellers: How they are removed and replaced from an engine and how to operate them.

Defined Outcome Students will describe how to remove and replace an automatic, two-position, and a ground adjustable propellor from an engine and define the principles of operation.

5.0 CONSTANT SPEED PROPELLERS AND GOVERNORS

Instructional Goal Know the system operation, components, and how to inspect and service a constant speed prop and governor.

Defined Outcome Students will describe constant speed prop system operation for different assembly types, identify system components, describe overhaul procedures, inspect and service a constant speed prop and its governor on an operational aircraft engine.

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6.0 FEATHERING AND REVERSING PROPELLERS

Instructional Goal Understand the operation and system components of a feathering and a reversing prop assembly.

Defined Outcome Students will identify and describe the operation for different feathering and reversing prop types; and identify the system and components for each prop type.

7.0 PROPELLER AUXILIARY SYSTEMS

Instructional Goal Know prop ice elimination, synchronizing, and automatic feathering systems. Identify system components and understand their function and inspection and servicing requirements.

Defined Outcome Students will identify and describe the operation for different ice elimination, prop synchronizing, and automatic feathering systems. Using aircraft components and manufacturers' data the students will identify system problems, and probable solutions to those problems.

8.0 INSTALLATION OF AIRCRAFT ENGINE ON AIRFRAME

Instructional Goal Know the reasons for properly preparing an aircraft engine for installation onto an aircraft, and the importance of having all systems on the aircraft ready to accept the powerplant.

Defined Outcome The student will describe and be able to make functional all the systems that connect an engine to an airframe, and know the various methods for lifting and moving the engine.

9.0 PREPARATION OF ENGINE FOR OPERATIONAL CHECK

Instructional Goal Know the location and operation of all components on an aircraft that portray and control the power of the engine. Identify all of the components used in preoiling and fueling an aircraft and the use of engine test equipment.

Defined Outcome The student will identify and describe the operation of all instrumentation and controls related to the operation of an aircraft engine. Using available test equipment the student will demonstrate the proper usage and techniques of the equipment in determining normal engine operation.

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10.0 PREPARATION OF AIRFRAME FOR OPERATION

Instructional Goal Know the location and operation of all airframe instruments and controls that affect engine operation and how to service aircraft liquid.

Defined Outcome Students will demonstrate their knowledge of the parameters of aircraft control systems, what effects the controls have over over the operation of the engine, and how to properly fuel numerous types of aircraft.

11.0 STARTING AND OPERATION OF AN AIRCRAFT ENGINE

Instructional Goal Know the procedures for starting and operating a reciprocating engine and the methods of trouble shooting to be used when the procedures fail.

Defined Outcome The student will show how to obtain the information for starting and operating an engine; and then follow the data to actually start and run an engine until all engine systems have stabilized. The students will show how to follow troubleshooting procedures in the event the engine does not run.

12.0 RECORDING OPERATIONAL DATA

Instructional Goal Know methods of documenting data on engine performance.

Defined Outcome The student will identify methods of recording engine operational data, demonstrate proficiency in charting engine performance and observing critical ranges and documenting operation results.

13.0 ENGINE COMPONENTS CHECK

Instructional Goal Know the primary purpose of systems check of engine components and how to determine if a malfunction is occurring.

Defined Outcome Student will perform a cylinder compression check and determine results of a low compression cylinder, Determine propeller ignition, and induction problems and methods of repair.

14.0 FINAL ENGINE OPERATION ADJUSTMENT

Instructional Goal Know how to adjust fuel and oil pressure, idle speed, mixture, ntrol cushion, prop governor, carburetor heat and engine oil temperature, and the operation of cylinder head temperature systems, engine power and the sequence of movement of engine controls.

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Defined Outcome The student will show operational sequence of engine power controls, the rigging of controls to obtain the proper control cushion, and will adjust engine and fuel pump pressures. The student will install a cylinder head temperature and an engine oil temperature system, a carburetor heat control and propeller governor system, and will correctly set the idle mixture and idle speed, and show the red lines for full power, and the normal operational ranges of all engine instrumentation.

15.0 AIRCRAFT ENGINE AIRWORTHINESS AND LOGBOOKS

Instructional Goal Know where to find information on engine/component compatibility, airworthiness directives and how to use maintenance and service manuals.

Defined Outcome Students will demonstrate their skill and knowledge of the Federal Aviation Regulations by identifying those airworthiness directives applicable to their project engine and making correct engine and airframe logbook entries.

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A T 260L AIRCRAFT RECIPROCATING ENGINE AND PROPELLER INSTALLATION AND OPERATION LAB

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FAR 147 APPENDIX D (POWERPLANT)

ITEM	LEVEL		
1	1		Inspect and repair 14-cylinder or larger radial engine.
3	3		Inspect, check, service, and repair opposed and radial engines and reciprocating engine installations.
4	3	*	Install, troubleshoot, and remove reciprocating engines.
8	3		Perform powerplant conformity and airworthiness inspections.
9	2		Troubleshoot, service, and repair fluid rate-of-flow indicating systems.
10	3		Inspect, check, service, troubleshoot, and repair engine temperature, pressure, and r.p.m. indicating systems.
11	3		Inspect, check, service, troubleshoot, and repair engine fire detection and extinguishing systems.
14	2		Identify and select lubricants.
15	2	*	Repair engine lubrication system components.
16	3		Inspect, check, service, troubleshoot, and repair engine lubrication systems.
17	2	**	Overhaul magneto and ignition harness.
18	2	**	Repair engine ignition system components.
19	3	**	Inspect, check, service, troubleshoot, and repair reciprocating and turbine engine ignition systems.
29	2	*	Repair engine cooling system components.
30	3	*	Inspect, check, troubleshoot, service, and repair engine cooling systems.
31	2	***	Repair engine exhaust system components.
32	3	***	Inspect, check, troubleshoot, service, and repair engine exhaust system.
33	1		Inspect, check, service, and repair propeller synchronizing and ice control systems.
34	2		Identify and select propeller lubricants.
35	2		Balance propellers
36	2		Repair propeller control system components.
37	3		Inspect, check, service and repair fixed-pitch, constant-speed, and feathering propellers, and propeller governing systems.
38	3		Install, troubleshoot, and remove propellers.

* Troubleshooting and repair performed in AT 267

** Ignition systems and component overhaul and repair performed in AT 163

*** Inspection, troubleshooting and repair performed in AT 266

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A T 260L AIRCRAFT RECIPROCATING ENGINE AND PROPELLER INSTALLATION AND OPERATION LAB

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Students enrolled in this course will become proficient in the installation, preparation, performance testing and troubleshooting of aircraft reciprocating engines.

b. Credits: Students will receive 3 credits for successful completion of this course.

c. Hours: The course is scheduled to meet 5 hours per week for 15 weeks each semester (4500 min) in class. In addition 3600 min. of outside work is expected for a total student involvement of 8100 minutes.

d. The 71 hours of instruction accounts for two holidays and is devoted entirely to laboratory and shop exercises.

e. This course is required for completion of the Associate of Applied Science degree or Certificate program in Aviation Maintenance.

f. Lab Fees: Lab fees for this course are outlined in Appendix A.

g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level position in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations in the accompanying lecture course precedes preplanned, structured lab exercises that allow the students to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance functions in reciprocating engine operation and installation. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of mathematics, physics, aviation publications, aircraft hardware, reciprocating engines, powerplant and electrical systems. This working knowledge may be demonstrated in the following ways:

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A T 260L AIRCRAFT RECIPROCATING ENGINE AND PROPELLER INSTALLATION AND OPERATION LAB

A T	160	Aircraft Information, Regulations and Procedures
A T	161	Aircraft Assembly
A T	161L	Aircraft Assembly Lab
A T	163	Aircraft Electrical Components
A T	163L	Aircraft Electrical Components Lab
A T	165	Aircraft Reciprocating Engine Theory and Overhaul
A T	165L	Aircraft Reciprocating Engine Theory and Overhaul Lab
PHYS	110	Physics for Technicians

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

c. Must be taken concurrently with AT 260, Aircraft Reciprocating Engine and Propeller Installation and Operation Lecture.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for make-up are outlined in Appendix B.

b. Class performance is evaluated by written or oral quizzes or tests and class participation.

V. OUTLINE

1.0 Aircraft Engine Assembly
  1.1 Ignition system
  1.2 Induction system
  1.3 Fuel system
  1.4 Engine cooling and cowling system

2.0 Propeller Theory and FAR's
  2.1 Nomenclature of propeller components
  2.2 Theory of operation
  2.3 Propeller FAR's

3.0 Fixed Pitch Propellers
  3.1 Wood propellers and components
  3.2 Metal propellers and components
  3.3 Fixed pitch propeller installation
  3.4 Tracking and balancing
  3.5 Remove and replace propellers

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4.0 Ground Adjustable and Automatic Propellers
- 4.1 Ground adjustable propellers
- 4.2 Automatic propellers
- 4.3 Two-position propellers
- 4.4 Propeller removal and replace

5.0 Constant Speed Propellers and Governors
- 5.1 System operation
- 5.2 Components
- 5.3 Manufacturers
- 5.4 Inspection and servicing
- 5.5 Blade-to-hub assembly
- 5.6 Remove and replace propeller and governor

6.0 Feathering and Reversing Propellers
- 6.1 Feathering operation and manufacturers
- 6.2 Feathering system and components
- 6.3 Reversing operation and manufacturers
- 6.4 Reversing system and components

7.0 Propeller Auxiliary Systems
- 7.1 Synchronization systems
- 7.2 Automatic feathering

8.0 Removal and Installation of Aircraft Engine on Airframe
- 8.1 Prepare engine for removal by draining fluids, securing and identifying fluid lines and controls.
- 8.2 Attach hoist and remove engine
- 8.3 Prepare engine for installation
- 8.4 Prepare airframe for engine
- 8.5 Hoisting methods

9.0 Preparation of Engine for Operational Check.
- 9.1 Instruments
- 9.2 Engine controls
- 9.3 Test equipment
- 9.4 Pre-oiling
- 9.5 Fuel servicing
- 9.6 Propeller installation

10.0 Preparation of Airframe for Operation
- 10.1 Instruments
- 10.2 Airframe controls
- 10.3 Fuel servicing

11.0 Starting and Operation of Aircraft Engine
- 11.1 Start procedures
- 11.2 Operation procedures
- 11.3 Troubleshoot

12.0 Recording Operational Data
- 12.1 Methods
- 12.2 Data sheets

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- 12.3 Engine Instruments and Indications
  - a. RPM
  - b. Manifold pressure
  - c. Fuel flow
  - d. EGT
  - e. Cylinder head temperature
  - f. Oil pressure
  - g. Oil temperature
  - h. Fuel pressure
- 12.4 Charting engine performance
- 12.5 Engine/propeller critical ranges
- 12.6 Documenting results

13.0 Engine Components Check
- 13.1 Cylinder compression
- 13.2 Ignition system
  - a. Magneto-to-engine timing
  - b. Operation of starting aids
- 13.3 Induction and fuel system
- 13.4 Cooling system
- 13.5 Propeller
- 13.6 Instrument accuracy and calibration
  - a. Track
  - b. Manifold pressure
  - c. Fuel flow
  - d. EGT
  - e. Cylinder head temperature
  - f. Oil pressure
  - g. Oil temperature
  - h. Fuel pressure

14.0 Final Engine Operation Adjustment
- 14.1 Engine oil pressure
- 14.2 Fuel pump pressure
- 14.3 Cylinder head temperature
- 14.4 Engine oil temperature
- 14.5 Engine power
- 14.6 Carburetor heat control
- 14.7 Propeller governor
- 14.8 Idle speed and mixture
- 14.9 Engine control cushion and stops
- 14.10 Basic operational sequence

15.0 Aircraft Engine Airworthiness and Log books
- 15.1 Engine components check
- 15.2 Logbooks and aircraft/engine records
- 15.3 FAR's
- 15.4 Airworthiness directives
- 15.5 Manufacturers' service publications
- 15.6 Operations manual

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VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 AIRCRAFT ENGINE ASSEMBLY

Instructional Goal Know the primary sub-systems of an aircraft reciprocating engine and their importance to the operation of an engine.

Defined Outcome The students will assemble the ignition, induction and fuel systems to a reciprocating engine in an airworthy manner

2.0 PROPELLER THEORY AND FAR'S

Instructional Goal Know the theory of operation of an aircraft propeller, its components, and FAR's.

Defined Outcome Students will identify all the parts of an aircraft propeller, the theory of operation and explain propeller Federal Aviation Regulations.

3.0 FIXED PITCH PROPELLERS

Instructional Goal Know the primary components of a wood and metal fixed pitch prop, installation and tracking procedures.

Defined Outcome Students will identify components of wood and metal propellers and will demonstrate on their project engine how to install and track a propeller.

4.0 GROUND ADJUSTABLE AND AUTOMATIC PROPS

Instructional Goal Know the history and applications of ground adjustable, automatic and two position propellers: How they are removed and replaced from an engine and how to operate them.

Defined Outcome Students will describe how to remove and replace an automatic, two-position, and a ground adjustable propellor from an engine and define the principles of operation.

5.0 CONSTANT SPEED PROPELLERS AND GOVERNORS

Instructional Goal Know the system operation, components, and how to inspect and service a constant speed prop and governor.

Defined Outcome Students will describe constant speed prop system operation for different assembly types, identify system components, describe overhaul procedures, inspect and service a constant speed prop and its governor on an operational aircraft engine.

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6.0 FEATHERING AND REVERSING PROPELLERS

Instructional Goal Understand the operation and system components of a feathering and a reversing prop assembly.

Defined Outcome Students will identify and describe the operation for different feathering and reversing prop types; and identify the system and components for each prop type.

7.0 PROPELLER AUXILIARY SYSTEMS

Instructional Goal Know prop ice elimination, synchronizing, and automatic feathering systems. Identify system components and understand their function and inspection and servicing requirements.

Defined Outcome Students will identify and describe the operation for different ice elimination, prop synchronizing, and automatic feathering systems. Using aircraft components and manufacturers' data the students will identify system problems, and probable solutions to those problems.

8.0 INSTALLATION OF AIRCRAFT ENGINE ON AIRFRAME

Instructional Goal Know the reasons for properly preparing an aircraft engine for removal from and installation onto an aircraft, and the importance of having all systems on the aircraft ready to accept the powerplant.

Defined Outcome The student will describe and be able to make functional all the systems that connect an engine to an airframe, and know the various methods for lifting and moving the engine.

9.0 PREPARATION OF ENGINE FOR OPERATIONAL CHECK

Instructional Goal Know the location and operation of all components on an aircraft that portray and control the power of the engine. Identify all of the components used in preoiling and fueling an aircraft and the use of engine test equipment.

Defined Outcome The student will identify and describe the operation of all instrumentation and controls related to the operation of an aircraft engine. Using available test equipment the student will demonstrate the proper usage and techniques of the equipment in determining normal engine operation.

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10.0 PREPARATION OF AIRFRAME FOR OPERATION

Instructional Goal Know the location and operation of all airframe instruments and controls that affect engine operation and how to service aircraft liquid.

Defined Outcome Students will demonstrate their knowledge of the parameters of aircraft control systems, what effects the controls have over over the operation of the engine, and how to properly fuel numerous types of aircraft.

11.0 STARTING AND OPERATION OF AN AIRCRAFT ENGINE

Instructional Goal Know the procedures for starting and operating a reciprocating engine and the methods of trouble shooting to be used when the procedures fail.

Defined Outcome The student will show how to obtain the information for starting and operating an engine; and then follow the data to actually start and run an engine until all engine systems have stabilized. The students will show how to follow troubleshooting procedures in the event the engine does not run.

12.0 RECORDING OPERATIONAL DATA

Instructional Goal Know methods of documenting data on engine performance.

Defined Outcome The student will identify methods of recording engine operational data, demonstrate proficiency in charting engine performance and observing critical ranges and documenting operation results.

13.0 ENGINE COMPONENTS CHECK

Instructional Goal Know the primary purpose of systems check of engine components and how to determine if a malfunction is occurring.

Defined Outcome Student will perform a cylinder compression check and determine results of a low compression cylinder, Determine propeller ignition, and induction problems and methods of repair.

14.0 FINAL ENGINE OPERATION ADJUSTMENT

Instructional Goal Know how to adjust fuel and oil pressure, idle speed, mixture, control cushion, prop governor, carburetor heat and engine oil temperature, and the operation of cylinder head temperature systems, engine power and the sequence of movement of engine controls.

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Defined Outcome The student will show operational sequence of engine power controls, the rigging of controls to obtain the proper control cushion, and will adjust engine and fuel pump pressures. The student will install a cylinder head temperature and an engine oil temperature system, a carburetor heat control and propeller governor system, and will correctly set the idle mixture and idle speed, and show the red lines for full power, and the normal operational ranges of all engine instrumentation.

15.0 AIRCRAFT ENGINE AIRWORTHINESS AND LOGBOOKS

Instructional Goal Know where to find information on engine/component compatibility, Airworthiness Directives and how to use Maintenance and Service Manuals.

Defined Outcome Students will demonstrate their skill and knowledge of the Federal Aviation Regulations by identifying those Airworthiness Directives applicable to their project engine and making correct engine and airframe logbook entries.

VII. OUTLINE (PROJECTS)

1.0 Aircraft Engine Removal and Installation
  1.1 Prepare engine for removal from airframe. Secure, cap and identify all lines and controls and perform engine removal.
  1.2 Prepare engine for installation on the airframe, including assembly of the induction system, electrical system, the ignition system, and all necessary accessories.
  1.3 Prepare the airframe to receive the engine and insure all line and electrical connections are ready for assembly.
  1.4 Demonstrate hoisting methods available to raise the engine and attach to the airframe safely and securely.

2.0 Prepare Engine for Operation
  2.1 Attach all lines, fittings and connections
  2.2 Attach and rig all control systems
  2.3 Attach and secure instrumentation in an airworthy manner
  2.4 Service engine with all required fluids
  2.5 Pre-oil engine

3.0 Operate Engine and Record Data
  3.1 Follow recommended start procedures, by using an itemized check sheet
  3.2 Operate engine using manufacturers' procedures
  3.3 Record operation of engine using approved data sheets
  3.4 Chart engine performance
  3.5 Identify engine/prop critical ranges

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3.6 Make engine log book entries
3.7 Instrumentation check for accuracy: e.g. tachometer, EGT, Fuel Flow, etc.

4.0 Engine Adjustments
4.1 Make oil pressure adjustment to bring oil pressure in green area.
4.2 Follow the manufacturers' recommendations to adjust the fuel pump pressure
4.3 Document the CHT and oil temperature ranges, and demonstrate what to do if temperatures are out of limits.
4.4 Demonstrate acceptable knowledge of the power control (throttle) and the power ranges of the powerplant.
4.5 Operate and check the carburetor heat control for proper operation and rigging.
4.6 Demonstrate on an aircraft or a mockup how to properly rig a propeller governor and what engine/propeller performance will result.
4.7 Adjust the engine idle speed and mixture until proper engine operation results.
4.8 Research and report on the propeller, throttle mixture and carb heat control cushion and adjust accordingly.
4.9 Demonstrate leaning procedures for use at high power and altitude.

5.0 Cylinder Compression Check
5.1 Perform a compression check on a reciprocating engine using a differential compression tester and record results.
5.2 Demonstrate acceptable knowledge on determining what the test results indicate on low compression cylinders.

6.0 Ignition System
6.1 Confirm E-gap setting.
6.2 Time magnetos to engine on Continental and Lycoming.
6.3 Perform harness check.
6.4 Check ignition switch operation.
6.5 Demonstrate proper use of magneto to cylinder timing equipment.

7.0 Lubrication System.
7.1 Select proper lubricants and service
7.2 Check leaks
7.3 Check for correct oil pressure and adjust as necessary.
7.4 Check for metal contamination of an engine.

8.0 Induction System
8.1 Demonstrate how to locate and correct an induction system leak.

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9.0 Fuel System
- 9.1 Demonstrate the correct method of locating a fuel system malfunction and properly correct the problem. e.g. primer leak, filter block, improper float setting.

10.0 Cooling System.
- 10.1 Show how to locate cooling system malfunctions: e.g. baffling, cowlflaps, cowllips, cowlseals.

11.0 Logbook Entries
- 11.1 Describe work accomplished, engine components checked, airworthiness directives compliance, and airworthiness status of engine.

12.0 Propeller Specifications
- 12.1 Using specification sheets, FAR's and manufacturers' technical data. Determine the airworthiness of a propeller.

13.0 Propeller Blending
- 13.1 Demonstrate correct procedures for repairing minor blade damage to an aluminum propeller and return it to service.

14.0 Propeller Tracking and Protractor Use
- 14.1 Demonstrate a correct prop tracking method and determine the prop blade angle with the prop protractor.

15.0 Propeller Governor
- 15.1 Rig and properly adjust a constant speed governor for a propeller and draw a schematic showing underspeed, on speed, and overspeed conditions.

16.0 Constant Speed Propellers
- 16.1 Remove and replace a constant speed propeller assembly using manufacturer's service instructions and record results on a lab data sheet.

17.0 Rotor Balance and Track
- 17.1 Use Chadwick Whirligig to detect and recommend correction for an out-of-balance and out- of-track situation following manufacturer's service instructions.

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FAR 147 APPENDIX C (AIRFRAME)

ITEM	LEVEL	
41	1	Fuel dump systems (check and service).
42	1	Perform fuel management, transfer and defueling.
43	1	Pressure fueling systems (inspect, check and repair).
44	2	Repair aircraft fuel system components.
45	2	Inspect and repair fluid quantity indication systems.
46	2	Troubleshoot, service and repair fluid pressure and warning systems.
47	3	Aircraft fuel systems (inspect, check, service, troubleshoot and repair).

Appendix D (Powerplant)

20	1	Water Injection System (inspect , check and service).
21	2	Carburetor (overhaul).
22	2	Repair engine fuel metering system components.
23	3	Inspect, check, service, troubleshoot and repair a reciprocating and turbine engine fuel metering system.
24	2	Repair engine fuel system components.
25	3	Inspect, check, service, troubleshoot and repair engine fuel system.
26	2	Inspect, check, troubleshoot, service and repair engine ice and rain control system.
27	2	Inspect, check, service and repair heat exchangers and superchargers.
28	3	Inspect, check, service and repair carburetor air intake and induction manifolds.

NOTE: Turbine fuels and fuel systems covered in detail in AT 262.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Beginning with aircraft fuels, fuel/air mixtures, basic fuel systems and fuel metering devices, the student will learn applications of fuels and metering systems to aircraft. Areas covered include complex aircraft systems, float carburetors, pressure carburetors, fuel injection systems, turbo-chargers, and superchargers.

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b. Credits: Students will receive 3 credits for successful completion of this course.

c. Hours: The class is scheduled to meet 4 hours per week for fifteen weeks each semester (3600 min.) in class. In addition (4500 min.) outside work is expected for total student involvement of (8100 min.).

d. The 59 hours of instruction accounts for two holidays and is devoted entirely to formal classroom presentations.

e. This course is required for completion of the Associate of Applied Science degree or Certificate program in Aviation Maintenance.

f. Lab Fee: No lab fees

g. This course in conjunction with the AMT curriculum, prepares an individual for entry level position in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations will precede preplanned structured lab exercises that allow the student to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance functions on fuel systems and metering units. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of aircraft maintenance data, physics, math , aviation publications and aircraft hardware before entering this course. This working knowledge may be demonstrated in the following ways:

a. Passing the following courses or their equivalent with a grade of "C" or better.
A T 160 Aircraft Information, Regulations and Procedures
A T 161 Aircraft Assembly
A T 161L Aircraft Assembly Lab
Phys 110 Physics for Technicians

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

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IV. EVALUATION

a. Class attendance is mandatory. Effects of students absences and methods for make-up are outlined in Appendix B.

b. Class performance will be evaluated by written or oral quizzes or tests and class participation.

V. OUTLINE

1.0 Fuels
  1.1 History of petroleum origin
  1.2 Development of manufacturing processes of fuels
  1.3 Types of fuels and fuel additives; octane, vapor pressure, specs. AVGAS/AUTOGAS .
  1.4 Types of fuel applications to aircraft/engines.
  1.5 Heat energy transformation, chemical conversion, and by-products
  1.6 Fuel contamination
  1.7 Methods of contamination prevention

2.0 Fuel Handling
  2.1 Storage facilities: design and purpose of ground handling (temporary and permanent).
  2.2 Safety: features of facilities, aircraft ground handling, equipment, access and servicing, filtering systems and maintenance - personal safety.
  2.3 Aircraft fueling and defueling. defueling methods of operation, outside of hangars, grounding, ventilation, containers, no sparking, fueling, heavy aircraft, pressure systems, light aircraft gravity feed, grounding, quantity assessment , gallons and weight.
  2.4 Fuel Transfer: system designs, operation, safety C.G. loading, engine consumption and servicing.

3.0 Airframe Fuel Systems and Components
  3.1 Basic airframe fuel systems
  3.2 Basic airframe fuel system components, tanks, filler caps, lines, fittings, valves, filters, pumps, switches and quantity indicators.
  3.3 Complex airframe fuel systems
  3.4 Complex airframe fuel system components, tanks, filler caps, quantity indicators, pressure indicators, temperature warning indicators, lines, fittings, valve assemblies, filters, screens, pumps (transfer), and switches and circuit breakers.
  3.5 Heavy complex airframe and fuel system
  3.6 Heavy, complex airframe fuel system components: tanks, filler caps, quantity indicators, pressure indicators, temperature warning indicators, lines, fittings, valves, pumps, switches, circuit breakers, screens and filters.

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3.7 Tanks: types of construction, metal, rubber, intergal. Testing methods. FAR's and removal and replacement and sump inspection.

3.8 Filler Caps: design for gravity and pressure systems. (FAR 23,25).

3.9 Fuel Quantity Indicator types: direct reading float (mechanical and electrical) and electronic FAR's and methods of removing and replacing.

3.10 Pressure Indicators: types of construction aircraft applicable. FAR's. Remove and replacing.

3.11 Lines: types of construction: rubber and metal. Assembly methods, supporting, lagging and maintenance.

3.12 Fittings: applications to aircraft fuel systems AN, MS and airframe manufacturers. Remove and replacement.

3.13 Pumps: design types e.g. diaphragm, centrifugal, piston, wobble, gear, vane construction, purpose of application, mounting, power source, pressure relief systems, bypass systems and adjustment.

3.14 Switches: purpose, design features, and maintenance and switch circuit breakers.

3.15 Valve assemblies: purpose, types: on-off and tank selection. Remove and replacement.

3.16 Filter assemblies sumps and screens: purpose, servicing, inspection and safetying methods.

3.17 Fuel management

    a. System designs, operation, safety C.G. loading, engine consumption and servicing.
    b. Fuel dumping: inflight operation, purpose, servicing. FAR's and safety precautions.

4.0 Powerplant Fuel Systems and Components

4.1 Powerplant fuel systems: application, purpose, servicing and troubleshooting of single engine aircraft and complex aircraft.

4.2 Firewall on-off valves: design, (large or small aircraft), manual or electric, safety (fire), backup systems.

4.3 Lines: construction types, rubber and metal, supporting methods, heat shielding and safety features.

4.4 Fittings: design applications, safety, grounding, abrasion and maintenance.

4.5 Filters and screens: types of design, purpose, safetying, servicing and mounting.

4.6 Pumps: purpose, (pressurize fuel to engine fuel metering device), types of design, engine applications, mounting, servicing, pressure relief valves, bypass systems and adjustments.

4.7 Pressure indicating systems: purpose, types of contruction, applications, troubleshooting and servicing devices.

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- 4.8 Primer assemblies: design features, purpose of application, engine starting, removing, and replacement, servicing, and troublshooting.
- 4.9 Instrumentation: EGT, CHT, fuel flow indicators.

5.0 Powerplant Fuel Metering Units

- 5.1 Float carburetors:
  - a. General: float carburetors: fuel/air mixture to power curves, power/economy curves, principles of operation, Bernoulis principle, fuel pressure requirement. FAR's servicing (carburetor systems and floats). Remove and replace.
  - b. Sub-Systems: float carburetors: five systems, (main metering, idle, mixture, accelerator and economizer) six parts, (float assembly, discharge nozzle, idle jet, mixture control, accelerator components and economizer assembly). Requirements of servicing and troubleshooting.
  - c. Carburetor application and installation: float carburetors: model number to engine size, correlation to aircraft types, idle speed and mixture adjustment, throttle and mixture linkage and control stops, power modes and critical ranges.
- 5.2 Pressure Carburetors:
  - a. Principles of operation e.g. (chambers; ram air, venturi air, metered fuel, unmetered fuel), fuel pressure requirements, FAR's, servicing. Remove and replace.
  - b. Pressure carburetors: accessory components; automatic mixture control (AMC), principles of operation, servicing. Remove and replace and troubleshooting; vapor separators, E-chamber, operation and servicing; anti-detonation injection (ADI), system principles of operation, components; servicing and troubleshooting. Discharge nozzle design, principles of operation and servicing.
  - c. Pressure carburetors, system operation check, servicing, repair and troubleshooting engine/carburetor applications.
- 5.3 Bendix continuous flow fuel injection systems: Bendix application components, modes of operation, servicing repair and troubleshooting.
- 5.4 Continental continuous flow fuel injection system, aircraft applications, components, servicing and troubleshooting.

6.0 Induction Systems

- 6.1 Naturally aspirated induction systems, principles of operation, systems and components
- 6.2 Cowling: design, principles of operation, servicing components, (air scoop and air filter).

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6.3 Induction System: components, (piping, seals, throttle valve and carburetor heat control). Servicing and troubleshooting.
6.4 Supercharged Induction Systems: Principle of operation components.
6.5 Turbochargers
   a. Principles of operation
   b. Components
      b.1 Turbine assembly
      b.2 Oil supply
      b.3 Waste gate
      b.4 Controller
      b.5 Intercooler
      b.6 Pop-off valve
      b.7 Instrumentation
   c. Servicing: decoding, inspection
   d. Troubleshooting
6.6 Horizontally opposed turbocharged system. Continental system review, (pumps, heat exchangers and upper-deck pressure), remove, replace and troubleshoot.
6.7 Power recovery turbine system: overview

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 FUELS

Instructional Goal Know the history and development of the fuel types, grades and their application.

Defined Outcome Students will describe the origin of fuels, and the major methods of development, the fuel types and grades and the engine applications of various fuel grades.

Instructional Goal Know energy transformation and the by-products that result, sources of fuel contamination, and methods of prevention.

Defined Outcome Students will describe how energy is transformed from one state to another, how fuel becomes contaminated and those applicable methods of fuel contamination prevention.

2.0 FUEL STORAGE FACILITIES AND SAFETY: HANDLING AIRCRAFT FUELS

Instructional Goal Know equipment and methods used to safely handle fuel around aircraft.

Defined Outcome Students will explain procedures for safely fueling and defueling aircraft.

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3.0 AIRFRAME FUEL SYSTEMS AND COMPONENTS

Instructional Goal Know and recognize the design features of basic airframe fuel systems and their components.

Defined Outcome Students will identify each component of basic airframe fuel system and describe the operation of the whole fuel system.

Instructional Goal Know and recognize the design features of complex airframe fuel systems and their components.

Defined Outcome Students will identify each component and its purpose in a complex airframe fuel system and describe the operation of the entire system.

Instructional Goal Understand and recognize the design features of a complex heavy aircraft fuel system, and the components that make up the system.

FUEL TANKS AND CAPS

Instructional Goal Know tank and cap construction and methods of testing each.

Defined Outcome Students will describe methods of tank construction and the testing for leaks in a fuel tank and identify an airworthy fuel tank cap.

FUEL SYSTEM INDICATORS

Instructional Goal Know fuel quantity, pressure, and temperature warning indicators, their purpose and methods of servicing.

Defined Outcome Students will describe the operation of fuel quantity, fuel pressure, and fuel temperature warning indications.

FUEL SYSTEM LINES AND FITTINGS

Instructional Goal Know types of fuel system lines, methods routing and support, and fittings and their use.

Defined Outcome Students will describe and identify types of fuel lines and fittings and demonstrate how to service and repair them according to approved data.

FUEL PUMPS AND SWITCHES

Instructional Goal Know the prpose of pumps, the different designs of pump assemblies and the electrical switches that energize pumps

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Defined Outcome Students will define the principles of operation of a fuel boost pump. Students will describe where boost pumps and engine driven pumps are located in aircraft fuel systems and how to maintain them.

FUEL VALVE AND FILTER ASSEMBLIES

Instructional Goal Know the function of fuel valves, where they are located in a fuel system, and the purpose of filters, sumps, and screen assemblies.

Defined Outcome Students will describe the purpose of a fuel valve assembly, and identify manufacturers' data to properly service valve filters, sumps, and screen assemblies.

4.0 POWERPLANT FUEL SYSTEM

Instructional Goal Know the purpose of aircraft single engine and complex, powerplant fuel systems.

Defined Outcome Students will describe the purpose of a powerplant fuel system for single engine and complex, aircraft, and methods of servicing these systems.

POWERPLANT FUEL VALVES

Instructional Goal Know design features of manual and electric fuel valves and their primary function.

Defined Outcome Students will describe the working components of electric and manual fuel valves and explain why fuel valves are needed in a powerplant fuel system.

FUEL LINES AND FITTINGS

Instructional Goal Recognize, and understand the construction, support and safety methods used in fuel lines and fittings.

Defined Outcome Students will identify rigid and flexible fuel lines, and describe their installation and maintenance.

FILTERS AND PRIMER ASSEMBLIES

Instructional Goal Know types of designs, engine applications, and servicing procedures of filters and primer assemblies.

Defined Outcome Students will describe filter and primer assemblies, and their use.

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FUEL PUMPS AND PRESSURE INDICATORS

Instructional Goal Know pump designs and engine applications; Pressure indicator construction designs and applications.

Defined Outcome Students will describe the different types of pump and indicating system designs, and demonstrate how to service a pump and an indicating system.

5.0 POWERPLANT FUEL METERING UNITS

Instructional Goal Know the five systems and the six parts of a float carburetor.

Defined Outcome Students will describe and identify the operation of the main metering, idle, mixture, accelerator and economizer systems.

Instructional Goal Know relationship of fuel/air mixture, to power and economy curves, and the effects of mixture control and throttle position.

Defined Outcome Students will define fuel/air, power and economy curves, and the effects of mixture control and throttle position.

Instructional Goal Relate carburetor models to engine models of aircraft, How to set idle and mixture adjustments and the throttle and mixture control stops.

Defined Outcome Students will relate carburetor models to engine models of aircraft and describe idle and mixture adjustments.

POWERPLANT FUEL METERING UNITS: PRESSURE CARBURETORS

Instructional Goal Know the principles of operation, the chambers, fuel pressures, FAR's and servicing requirements.

Defined Outcome Students will explain the principles of operation of a pressure carburetor, the purpose of chambers, fuel pressures required and the standard procedures for removal and replacement of a pressure carburetor.

POWERPLANT FUEL METERING UNITS PRESSURE INJECTION SYSTEMS

Instructional Goal Know the primary components of a pressure injection system and understand the principles of operation of the system.

Defined Outcome Students will describe the principles of operation of a pressure injection system and define the purpose of the components in the system.

A T 261 AIRCRAFT FUEL SYSTEMS

POWERPLANT FUEL METERING UNITS CONTINUOUS FLOW FUEL INJECTION SYSTEMS

Instructional Goal Know the components of a Bendix, and a Continental fuel injection system and the methods used for servicing, repair and troubleshooting of the Bendix and Continental fuel injection system.

Defined Outcome Students will describe the operation of a Bendix and Continental fuel injection system, identify parts of the system and demonstrate methods of servicing and troubleshooting.

6.0 INDUCTION SYSTEMS: NATURALLY ASPIRATED

Instructional Goal Know the components needed for a naturally aspirated engine, the principles of operation and maintenance of the system.

Defined Outcome Students will describe the components of a naturally aspirated induction system, and their maintenance.

SUPERCHARGING SYSTEMS

Instructional Goal Know the principles of operation of a supercharger, the components needed in the system.

Defined Outcome Students will describe the principles of operation of a super-charger, define the components of the system.

INDUCTION SYSTEMS: TURBOCHARGED

Instructional Goal Know the principles of operation of a turbocharger system, the components, and the methods of servicing, maintenance and troubleshooting.

Defined Outcome Students will identify and describe turbocharger components, explain servicing and troubleshooting a turbocharger system.

Instructional Goal Know components and principles of operation of a power recovery turbine.

Defined Outcome Students will describe the operation of a power recovery turbine and identify the major components in the system.

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A T 261L AIRCRAFT FUEL SYSTEMS LABORATORY

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FAR 147 APPENDIX C (AIRFRAME)

ITEM	LEVEL	
41	1	Fuel dump systems (check and service).
42	1	Perform fuel management, transfer and defueling.
43	1	Pressure fueling systems (inspect, check and repair).
44	2	Repair aircraft fuel system components.
45	2	Inspect and repair fluid quantity indication systems.
46	2	Troubleshoot, service and repair fluid pressure and warning systems.
47	3	Aircraft fuel systems (inspect, check, service, troubleshoot and repair).

Appendix D (Powerplant)

20	1	Water Injection System (inspect , check and service).
21	2	Carburetor (overhaul).
22	2	Repair engine fuel metering system components.
23	3	Inspect, check, service, troubleshoot and repair a reciprocating and turbine engine fuel metering system.
24	2	Repair engine fuel system components.
25	3	Inspect, check, service, troubleshoot and repair engine fuel system.
26	2	Inspect, check, troubleshoot, service and repair engine ice and rain control system.
27	2	Inspect, check, service and repair heat exchangers and superchargers.
28	3	Inspect, check, service and repair carburetor air intake and induction manifolds.

NOTE: Turbine fuels and fuel systems covered in detail in AT 262.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Beginning with aircraft fuels, fuel/air mixtures, basic fuel systems and fuel metering devices, the student will learn applications of fuels and metering systems to aircraft. Areas covered include complex aircraft systems, float carburetors, pressure carburetors, fuel injection systems, turbo-chargers, and superchargers.

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b. Credits: Students will receive 1 credit for successful completion of this course.

c. Hours: The class is scheduled to meet three hours per week for fifteen weeks each semester (2700 min.) in class. In addition (1300 min.) outside work is expected for total student involvement of (4000 min.).

d. The 42 hours of instruction accounts for two holidays and is devoted entirely to laboratory instruction.

e. This course is required for completion of the Associate of Applied Science degree or Certificate program in Aviation Maintenance.

f. Lab fees for this course are outlined in appendix A.

g. This course in conjunction with the AMT curriculum, prepares an individual for entry level position in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations will precede preplanned structured lab exercises that allow the student to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance functions on fuel systems and metering units. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of aircraft maintenance data, physics, math, aircraft assembly, and basic reciprocating engines. This working knowledge may be demonstrated in the following ways:

a. Passing the following courses or their equivalent with a grade of "C" or better.

A T 160	Aircraft Information, Regulations and Procedures
A T 161	Aircraft Assembly
A T 161L	Aircraft Assembly Lab.
PHYS 110	Physics for Technicians

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

c. This course must be taken concurrently with AT 261 Lecture.

A T 261L AIRCRAFT FUEL SYSTEMS LABORATORY

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for make-up are outlined in Appendix B.

c. Lab performance will be evaluated by observation of student preparation, participation, technique and completion of lab projects and written reports.

V. OUTLINE

1.0 Fuels
  1.1 History of petroleum origin
  1.2 Development of manufacturing processes of fuels
  1.3 Types of fuels and fuel additives; octane, vapor pressure, specs. AVGAS/AUTOGAS .
  1.4 Types of fuel applications to aircraft/engines.
  1.5 Heat energy transformation, chemical conversion, and by-products
  1.6 Fuel contamination
  1.7 Methods of contamination prevention

2.0 Fuel Handling
  2.1 Storage Facilities: Design and purpose of ground handling, (temporary and permanent).
  2.2 Safety: features of facilities, aircraft ground handling, equipment, access and servicing, filtering systems and maintenance - personal safety.
  2.3 Aircraft fueling and defueling. Defueling methods of operation, outside of hangars, grounding, ventilation, containers, no sparking, fueling, heavy aircraft, pressure systems, light aircraft gravity feed, grounding, quantity assessment , gallons and weight.
  2.4 Fuel Transfer: System designs, operation, safety C.G. loading, engine consumption and servicing.

3.0 Airframe Fuel Systems and Components
  3.1 Basic airframe fuel systems
  3.2 Basic airframe fuel system components, tanks, filler caps, lines, fittings, valves, filters, pumps, switches and quantity indicators.
  3.3 Complex airframe fuel systems
  3.4 Complex airframe fuel system components, tanks, filler caps, quantity indicators, pressure indicators, temperature warning indicators, lines, fittings, valve assemblies, filters, screens, pumps (transfer), and switches and circuit breakers.
  3.5 Heavy complex airframe and fuel system

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3.6 Heavy, complex airframe fuel system components: tanks, filler caps, quantity indicators, pressure indicators, temperature warning indicators, lines, fittings, valves, pumps, switches, circuit breakers, screens and filters.

3.7 Tanks: types of construction, metal, rubber, intergal. Testing methods. FAR's and removal and replacement and sump inspection.

3.8 Filler Caps: Design for gravity and pressure systems. (FAR 23,25).

3.9 Fuel Quantity Indicator types: Direct reading float (mechanical and electrical) and electronic FAR's and methods of removing and replacing.

3.10 Pressure Indicators: Types of construction aircraft applicable. FAR's. Remove and Replacing.

3.11 Lines: Types of construction: Rubber and metal. Assembly methods, supporting, lagging and maintenance.

3.12 Fittings: Applications to aircraft fuel systems AN, MS and airframe manufacturers. Remove and replacement.

3.13 Pumps: Design types e.g. diaphragm, centrifugal, piston, wobble, gear, vane construction, purpose of application, mounting, power source, pressure relief systems, by-pass systems and adjustment.

3.14 Switches: Purpose, design features, and maintenance and switch circuit breakers.

3.15 Valve Assemblies: Purpose, types: on-off and tank selection. Remove and replacement.

3.16 Filter Assemblies sumps and screens: purpose, servicing, inspection and safetying methods.

3.17 Fuel management

   a. System designs, operation, safety C.G. loading, engine consumption and servicing.

   b. Fuel dumping: inflight operation, purpose, servicing. FAR's and safety precautions.

4.0 Powerplant Fuel Systems and Components

4.1 Powerplant fuel systems: application, purpose, servicing and troubleshooting of single engine aircraft and complex aircraft.

4.2 Firewall on-off valves: design, (large or small aircraft), manual or electric, safety (fire), back-up systems.

4.3 Lines: Construction types, rubber and metal, supporting methods, heat shielding and safety features.

4.4 Fittings: Design applications, safety, grounding, abrasion and maintenance.

4.5 Filters and screens: Types of design, purpose, safetying, servicing and mounting.

4.6 Pumps: Purpose, (pressurize fuel to engine fuel metering device), types of design, engine applications, mounting, servicing, pressure relief valves, bypass systems and adjustments.

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4.7 Pressure indicating systems: Purpose, types of contruction, applications, troubleshooting and servicing devices.

4.8 Primer assemblies: Design features, purpose of application, engine starting, removing and replacement, servicing, and troubleshooting.

4.9 Instrumentation; EGT, CHT, fuel flow indicators.

5.0 Powerplant Fuel Metering Units

5.1 Float carburetors:

a. General: float carburetors: fuel/air mixture to power curves, power/economy curves, principles of operation, Bernoulis principle, fuel pressure requirement. FAR's servicing (carburetor systems and floats). Remove and replace.

b. Sub-Systems: Float Carburetors: five systems, (main metering, idle, mixture, accelerator and economizer) six parts, (float assembly, discharge nozzle, idle jet, mixture control, accelerator components and economizer assembly). Requirements of servicing and troubleshooting.

c. Carburetor application and Installation: Float Carburetors: model number to engine size, correlation to aircraft types, idle speed and mixture adjustment, throttle and mixture linkage and control stops, power modes and critical ranges.

5.2 Pressure carburetors:

a. Principles of operation e.g. (chambers; ram air, venturi air, metered fuel, unmetered fuel), fuel pressure requirements, FAR's, servicing. Remove and replace.

b. Pressure carburetors: accessory components; automatic mixture control (AMC), principles of operation, servicing. Remove and replace and troubleshooting; vapor separators, E-chamber, operation and servicing; anti-detonation injection (ADI), system principles of operation, components; servicing and troubleshooting. Discharge nozzle design, principles of operation and servicing.

c. Pressure Carburetors, system operation check, servicing, repair and troubleshooting engine/carburetor applications.

5.3 Bendix Continuous flow fuel injection systems: Bendix applications components, modes of operation, servicing repair and troubleshooting.

5.4 Continental continuous flow fuel injection system, aircraft applications, components, servicing and troubleshooting.

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A T 261L AIRCRAFT FUEL SYSTEMS LABORATORY

6.0 Induction
- 6.1 Naturally aspirated induction systems, principles of operation, systems and components
- 6.2 Cowling: design, principles of operation, servicing components, (air scoop and air filter).
- 6.3 Induction system: Components, (piping, seals, throttle valve and carburetor heat control). Servicing and troubleshooting.
- 6.4 Supercharged induction systems: Principle of operation Components.
- 6.5 Turbochargers
    - a. Principles of operation
    - b. Components
        - b.1 Turbine assembly
        - b.2 Oil supply
        - b.3 Waste gate
        - b.4 Controller
        - b.5 Intercooler
        - b.6 Pop-off valve
        - b.7 Instrumentation
    - c. Servicing: decoding, inspection
    - d. Troubleshooting
- 6.6 Horizontally opposed turbocharged system. Continental System review, (pumps, heat exchangers and upper-deck pressure), remove, replace and troubleshoot.
- 6.7 Power recovery turbine system: Overview

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 FUELS

Instructional Goal Know the history and development of the fuel types, grades and their application.

Defined Outcome Students will describe the origin of fuels, and the major methods of development, the fuel types and grades and the engine applications of various fuel grades.

Instructional Goal Know energy transformation and the by-products that result, sources of fuel contamination, and methods of prevention.

Defined Outcome Students will describe how energy is transformed from one state to another, how fuel becomes contaminated and those applicable methods of fuel contamination prevention.

2.0 FUEL STORAGE FACILITIES AND SAFETY: HANDLING AIRCRAFT FUELS

Instructional Goal Know equipment and methods used to safely handle fuel around aircraft.

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Defined Outcome Students will explain procedures for safely fueling and defueling aircraft.

3.0 AIRFRAME FUEL SYSTEMS AND COMPONENTS

Instructional Goal Know and recognize the design features of basic airframe fuel systems and their components.

Defined Outcome Students will identify each component of basic airframe fuel system and describe the operation of the whole fuel system.

Instructional Goal Know and recognize the design features of complex airframe fuel systems and their components.

Defined Outcome Students will identify each component and its purpose in a complex airframe fuel system and describe the operation of the entire system.

Instructional Goal Understand and recognize the design features of a complex heavy aircraft fuel system, and the components that make up the system.

FUEL TANKS AND CAPS

Instructional Goal Know tank and cap construction and methods of testing each.

Defined Outcome Students will describe methods of tank construction and the testing for leaks in a fuel tank and identify an airworthy fuel tank cap.

FUEL SYSTEM INDICATORS

Instructional Goal Know fuel quantity, pressure, and temperature warning indicators, their purpose and methods of servicing.

Defined Outcome Students will describe the operation of fuel quantity, fuel pressure, and fuel temperature warning indications.

FUEL SYSTEM LINES AND FITTINGS

Instructional Goal Know types of fuel system lines, methods routing and support, and fittings and their use.

Defined Outcome Students will describe and identify types of fuel lines and fittings and demonstrate how to service and repair them according to approved data.

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FUEL PUMPS AND SWITCHES

Instructional Goal Know the purpose of pumps, the different designs of pump assemblies and the electrical switches that energize pumps.

Defined Outcome Students will define the principles of operation of a fuel boost pump. Students will describe where boost pumps and engine driven pumps are located in aircraft fuel systems and how to maintain them.

FUEL VALVE AND FILTER ASSEMBLIES

Instructional Goal Know the function of fuel valves, where they are located in a fuel system, and the purpose of filters, sumps, and screen assemblies.

Defined Outcome Students will describe the purpose of a fuel valve assembly, and identify manufacturers' data to properly service valve filters, sumps, and screen assemblies.

4.0 POWERPLANT FUEL SYSTEM

Instructional Goal Know the purpose of aircraft single engine and complex, powerplant fuel systems.

Defined Outcome Students will describe the purpose of a powerplant fuel system for single engine and complex, aircraft, and methods of servicing these systems.

POWERPLANT FUEL VALVES

Instructional Goal Know design features of manual and electric fuel valves and their primary function.

Defined Outcome Students will describe the working components of electric and manual fuel valves and explain why fuel valves are needed in a powerplant fuel system.

FUEL LINES AND FITTINGS

Instructional Goal Recognize, and understand the construction, support and safety methods used in fuel lines and fittings.

Defined Outcome Students will identify rigid and flexible fuel lines, and describe their installation and maintenance.

FILTERS AND PRIMER ASSEMBLIES

Instructional Goal Know types of designs, engine applications, and servicing procedures of filters and primer assemblies.

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Defined Outcome Students will describe filter and primer assemblies, and their use.

FUEL PUMPS AND PRESSURE INDICATORS

Instructional Goal Know pump designs and engine applications; Pressure indicator construction designs and applications.

Defined Outcome Students will describe the different types of pumps and indicating system designs, and demonstrate how to service a pump and an indicating system.

5.0 POWERPLANT FUEL METERING UNITS

Instructional Goal Know the five systems and the six parts of a float carburetor.

Defined Outcome Students will describe and identify the operation of the main metering, idle, mixture, accelerator and economizer systems.

Instructional Goal Know relationship of fuel/air mixture, to power and economy curves, and the effects of mixture control and throttle position.

Defined Outcome Students will define fuel/air, power and economy curves, and the effects of mixture control and throttle position.

Instructional Goal Relate carburetor models to engine models of aircraft, How to set idle and mixture adjustments and the throttle and mixture control stops.

Defined Outcome Students will relate carburetor models to engine models of aircraft and describe idle and mixture adjustments.

POWERPLANT FUEL METERING UNITS: PRESSURE CARBURETORS

Instructional Goal Know the principles of operation, the chambers, fuel pressures, FAR's and servicing requirements.

Defined Outcome Students will explain the principles of operation of a pressure carburetor, the purpose of chambers, fuel pressures required and the standard procedures for removal and replacement of a pressure carburetor.

POWERPLANT FUEL METERING UNITS PRESSURE INJETION SYSTEMS

Instructional Goal Know the primary components of a pressure injection system and understand the principles of operation of the system.

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Defined Outcome Students will describe the principles of operation of a pressure injection system and define the purpose of the components in the system.

POWERPLANT FUEL METERING UNITS CONTINUOUS FLOW FUEL INJECTION SYSTEMS

Instructional Goal Know the components of a Bendix, and a Continental fuel injection system and the methods used for servicing, repair and troubleshooting of the Bendix and Continental fuel injection system.

Defined Outcome Students will describe the operation of a Bendix and Continental fuel injection system, identify parts of the system and demonstrate methods of servicing and troubleshooting.

6.0 INDUCTION: NATURALLY ASPIRATED

Instructional Goal Know the components needed for a naturally aspirated engine, the principles of operation and maintenance of the system.

Defined Outcome Students will describe the components of a naturally aspirated induction system, and their maintenance.

SUPERCHARGING SYSTEMS

Instructional Goal Know the principles of operation of a supercharger, the components needed in the system.

Defined Outcome Students will describe the principles of operation of a super-charger, define the components of the system.

INDUCTION: TURBOCHARGED

Instructional Goal Know the principles of operation of a turbocharger system, the components, and the methods of servicing, maintenance and troubleshooting.

Defined Outcome Students will identify and describe turbocharger components, explain servicing and troubleshooting a turbocharger system.

Instructional Goal Know components and principles of operation of a power recovery turbine.

Defined Outcome Students will describe the operation of a power recovery turbine and identify the major components in the system.

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A T 261L AIRCRAFT FUEL SYSTEMS LABORATORY

FAA Level	VII. PROJECTS
2	1.0 Draw a schematic of a complete gravity fuel system.
3	2.0 Clean and service an aircraft fuel filter following the manufacturers' instructions.
2	3.0 Leak test an aircraft fuel tank.
2	4.0 Inspect operate and repair a fuel quantity indicating system.
3	5.0 Check an aircraft fuel tank sump for fuel type and contamination.
3	6.0 Clean and service a carburetor air filter using the manufacturers' instructions.
3	7.0 Disassemble, inspect, identify components, reassemble and shop test a small float-type aircraft carburetor.
2	8.0 Explain purpose, construction, and operation of typical pressure carburetor.
3	9.0 Inspect and repair a reciprocating engine primer system.
3	10.0 Induction System Leak Check and Inspection. Service and repair.
2	11.0 Fuel injection operation, inspection, adjustment and shoptest.

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A T 262 AIRCRAFT TURBINE ENGINES

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FAR 147 APPENDIX D (POWERPLANT)

ITEM	LEVEL	
5	2	Overhaul Turbine engines.
6	2	Inspect, check, service and repair turbine engines and turbine engine installations.
7	2	Install, troubleshoot and remove turbine engines.
19	3	Inspect, check, service, troubleshoot and repair reciprocating and turbine engine ignition systems.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Beginning with a brief section covering the historical development of the turbine engine, the student will be taught current aircraft applications and the names of engine manufacturers and the models which they produce. Theory of thrust development is explained along with design and environmental factors that influence thrust. Next, the student will be taught the construction details of a typical engine from inlet to exhaust. A detailed look at the support systems which a typical engine uses to operate under all modes of operation will follow. Finally, the student will be taught the operational characteristics of the typical engine and how to test run the engine on the aircraft or in the test cell.

b. Credits: Students will receive 3 credits for successful completion of this course.

c. Hours: The class is scheduled to meet 4 hours per week for 15 weeks each semester (3600 min.) in class. In addition (4500 min.) outside work is expected for total student involvement of (8100 min.).

d. The 58 hours of instruction accounts for two holidays and is devoted entirely to formal classroom presentations.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab fees: No lab fees.

A T 262 AIRCRAFT TURBINE ENGINES

g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations will precede preplanned, structured lab exercises that are presented in the accompanying laboratory courses and allow the students to observe and practice the tasks necessary to build skill and confidence in performing the required repair and inspection of turbine engines. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of math, physics, aviation publications and aircraft hardware before entering this course. Knowledge may be demonstrated in the following ways: Passing the following courses with a grade of "C" or better.

A T 160	Aircraft Information Regulations and Procedures
A T 161	Aircraft Assembly
A T 161L	Aircraft Assembly Lab
A T 163	Aircraft Electrical Components
A T 163L	Aircraft Electrical Components Lab
PHYS 110	Physics for Technicians

Demonstrating equivalent knowledge to the instructor's satisfaction by means of written exams, academic record or work history.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for makeup are outlined in Appendix B.

b. Class performance is evaluated by written or oral quizzes or tests and class participation.

V. OUTLINE

1.0 Historical Perspective
    1.1 Basic Whittle design
    1.2 Sequential improvements from 1934
    1.3 Current manufacturers, models and applications
        a. Turbojet
        b. Turboprop
        c. Turbofan and bypass ratios

A T 262 AIRCRAFT TURBINE ENGINES

- 2.0 Theory of Operation
  - 2.1 Newton's laws
  - 2.2 Gross thrust
  - 2.3 Net thrust
  - 2.4 Specific fuel consumption (SFC)
  - 2.5 Factors affecting thrust output
  - 2.6 Thrust to horsepower conversions

- 3.0 Construction Details
  - 3.1 Inlet ducts
  - 3.2 Compressors
  - 3.3 Burners
  - 3.4 Turbines
  - 3.5 Exhaust
  - 3.6 Thrust augmentation
    - a. After burners
    - b. Water injection
  - 3.7 Thrust reversers

- 4.0 Support Systems
  - 4.1 Fuel
    - a. Turbine fuels and their characteristics
    - b. Components
    - c. Theory of operation of components
    - d. Field adjustments
    - e. Troubleshooting cause and effect
  - 4.2 Lubrication
    - a. Turbine lubricants and their characteristics
    - b. Components
    - c. Theory of operation of components
    - d. Field adjustments
    - e. Troubleshooting cause and effect
  - 4.3 Ignition
    - a. Components
    - b. Theory of operation of components
    - c. Field adjustments
    - d. Troubleshooting cause and effect
  - 4.4 Starting
    - a. Components
    - b. Theory of operation
  - 4.5 Instrumentation Systems
    - a. RPM
    - b. Fuel flow
    - c. EGT
    - d. EPR (engine pressure ratio)
    - e. Oil pressure
    - f. Oil temperature
    - g. Oil quantity
    - h. Engine indicating crude learning system
    - i. Built in test equipment
    - j. Torque
    - k. Negative torque sensing

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- 4.6 Bleed Air
  - a. Anti-ice
  - b. Surge control
  - c. Environmental
- 4.7 Governing Systems
  - a. Prop angle control
  - b. Fuel control
  - c. Protection governors

5.0 Materials and Construction Processes
- 5.1 Metalurgy, alloys, and coatings
  - a. Frames
  - b. Ducts
  - c. Blades
  - d. Vanes

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 HISTORICAL PERSPECTIVE

Instructional Goal Know the major developments from Whittle's first engine to the present. Know the current turbine engine manufacturers, models and airframe applications.

Defined Outcome The student will describe the development of the turbine engine from 1934 to the present. The student will list the major engine manufacturers and match the various engine model, aircraft combinations in use today.

2.0 THEORY OF OPERATION

Instructional Goal Know the fundamental physical laws that determine the level of thrust produced by a turbine engine. Know how to calculate thrust production levels. Know how to compare engines by use of SFC data. Know how to convert thrust into horsepower.

Defined Outcome The student will calculate gross and net thrust, SFC and Thrust Horsepower given the appropriate data and calculator. The student will list and explain the design and non-design factors that affect thrust and how the variables affect these factors. The student will trace the gas path through a typical engine. The student will identify the points of highest gas velocity, pressure and temperature in a typical engine.

A T 262 AIRCRAFT TURBINE ENGINES

3.0 CONSTRUCTION DETAILS

Instructional Goal Know the specifics of typical designs of the various section of a turbine engine. Know the variations of the basic engine designs and the different way these designs may be put together. Know construction nomenclature.

Defined Outcome The student will describe the design features of each of the 7 major sections of a turbine engine. The student will list the advantages and disadvantages of each construction design.

4.0 SUPPORT SYSTEMS

Instructional Goal Know the components, theory of operation, field adjustments and troubleshooting theory for each of the support systems normally found on a turbine engine.

Defined Outcome The student will list the components of each support system. The student will explain the theory of operation of each component and system. The student will identify field adjustments that can be made on support systems components. The student will describe how a given system defect will affect the operation of the engine.

5.0 MATERIALS

Instructional Goal Know the broad catagories of materials that are used to construct a turbine engine. Know in what engine section or system these materials are found. Know the general characteristics of each of these materials.

Defined Outcome The student will list the materials most likely to be used to construct a given section of a turbine engine. The student will list the major characteristics of each type of construction material.

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A T 262L AIRCRAFT TURBINE ENGINE LABORATORY

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FAR 147 Appendix D (powerplant)

Item	Level	
5	2	Overhaul Turbine Engines.
6	2	Inspect, check, service and repair turbine engines and turbine engine installations.
7	2	Install, troubleshoot and remove turbine engines.
19	3	Inspect, check, service, troubleshoot and repair reciprocating and turbine engine ignition systems.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: A laboratory course covering the disassembly, assembly, inspection and repair of aircraft turbine engines. The ability to use technical data and appropriate tools and inspection devices is stressed. Special safety procedures related to the servicing, operation and repair of turbine engines is stressed.

b. Credits: Students will receive 2 credits for successful completion of this course.

c. Hours: The class is scheduled to meet 4 hours per week for fifteen weeks each semester (3600 min.) in class. In addition (1800 min.) outside work is expected for total student involvement of (5400 min.).

d. The 60 hours of instruction accounts for two holidays and is devoted entirely to laboratory and shop exercises.

e. This course is required for completion of the Associate of Applied Science degree or Certificate program in Aviation Maintenance.

f. The lab fees for this course are outlined in Appendix A.

g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions into the aviation maintenance field.

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A T 262L AIRCRAFT TURBINE ENGINES LABORATORY

II. ACTIVITIES

Formal lecture and demonstrations in the accompanying lecture course precede preplanned, structured lab exercises that allow the students to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance functions on repair and inspection of turbine engines. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of math, physics, aviation publications and aircraft hardware before entering this course. This working knowledge may be demonstrated in the following ways:

A T 160	Aircraft Information, Regulations and Procedures
A T 161	Aircraft Assembly
A T 161L	Aircraft Assembly Lab
A T 163	Aircraft Electrical Components
A T 163L	Aircraft Electrical Components Lab
PHYS 110	Physics for Technicians

Demonstrating equivalent knowledge to the instructor's satisfaction by means of written exams, academic record, or work history. This course must be taken concurrently with AT 262 Aircraft Turbine Engines.

III. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for makeup are outlined in Appendix B.

b. Final grades are computed from quizzes, tests reports, lab projects and shop technique.

V. COURSE OUTLINE

1.0 Introduction to Laboratory Practices
    1.1 Safety and housekeeping in lab
    1.2 Technical data required

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A T 262L AIRCRAFT TURBINE ENGINES LABORATORY

2.0 Disassembly Practices
  2.1 Care of lines, fittings and hardware
  2.2 How to find special tools required
  2.3 Use of special tools
  2.4 Handling of oils and fuels found during disassembly
  2.5 Indexing
  2.6 Care and identification of hardware
  2.7 Proper storage of disassembled parts and modules

3.0 Inspection Processes
  3.1 Fault nomenclature
  3.2 Critical inspection areas for particular engines
  3.3 Borescope usage
  3.4 Compressor blade inspections
  3.5 Burner, liner and duct inspections
  3.6 Turbine blade and starter inspections
  3.7 Inlet and exhaust duct inspections
  3.8 Ignitor cleaning and inspection
  3.9 Seals and bearings

4.0 Repair
  4.1 How to determine allowed repairs
  4.2 Blending of compressor blades
  4.3 Repair of cracks in burner section
  4.4 Replacement of seals and bearings

5.0 Assembly
  5.1 Proper lubrication and indexing of parts
  5.2 Torquing and safetying of parts

6.0 Operation
  6.1 Prerun checks and safety practices
  6.2 Installing on aircraft or test stand
  6.3 Motoring checks
  6.4 Instrumentation checks
  6.5 Starting procedures
  6.6 Acceleration and deceleration checks
  6.7 Idle, part power trim adjustments
  6.8 Data collection and analysis
  6.9 Shut down procedures
  6.10 Troubleshooting problems from run data
  6.11 Repairing problems found during run.

LABORATORY PROJECT OUTLINE

FAA Level

1.0 Laboratory Practices
3   1.1 Research type certificate, service letters, service bulletins, airworthiness directives, maintenance manuals, and parts manuals for assigned engine.

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A T 262L AIRCRAFT TURBINE ENGINE LABORATORY

FAA Level

2.0 Disassembly Practices
2.1 Demonstrate methods of proper care of lines and hardware and components obtained during disassembly.
2.2 Demonstrate proper disposal of fuels and oils encountered during disassembly.
2 2.3 Demonstrate proper engine lifting and transporting methods.
2.4 Demonstrate preparation of work area to store disassembled parts.
2.5 Partially disassemble compressor section of Allison 250-C18, or Westinghouse J-34 or Lycoming T-53.
2.6 Partially disassemble turbine section on assigned engines.
2.7 Disassemble burner section on assigned engine.
2.8 Remove accessories, tag and store

3.0 Inspection
3.1 Clean all parts as required for inspection
2 3.2 Inspect compressor components for damage and record results in laboratory note book
3.3 Inspect turbine section and record
3.4 Inspect burner section and record
3.5 Inspect accessories for external condition and record.
3.6 Inspect and repair ignition system
3.7 Inspect, check, service, repair fuel metering system

4.0 Repair
2 4.1 Blend a scrap compressor blade
4.2 Replace a bearing and seal assembly
4.3 Remove and clean or remove and replace filters as required.

5.0 Assembly
2 5.1 Properly lubricate all parts as required
5.2 Check parts for proper indexing
5.3 Torque all fasteners
5.4 Safety wire fasteners if required
5.5 Install and check all lines and accessories

6.0 Operation and Testing
6.1 Accomplish and sign off prerun checks
2 6.2 Install engine on aircraft or test stand
6.3 Wet motoring checks
6.4 Check cell or aircraft instrumentation systems
6.5 Start, run and shutdown engine while recording test data.
6.6 Repair problems encountered during run
6.7 Demonstrate fuel control adjustments as required
6.8 Perform compressor wash as applicable.

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A T 262L AIRCRAFT TURBINE ENGINE LABORATORY

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 INTRODUCTION TO LABORATORY PRACTICES

Instructional Goal: Know proper handling practices of a turbine engine in the shop and test cell setting. Know how to research information in the technical data system and how to apply the researched information to engine maintenance.

Defined Outcomes: The student will describe the correct methods for transporting and caring for turbine engines and turbine engines components. The student will research type certificate data sheets, service letter, service bulletins, airworthiness directives and maintenance manuals for an assigned engine.

2.0 DISASSEMBLY PRACTICES

Instructional Goal: Know the proper methods and techniques and tools required to disassemble a turbine engine.

Defined Outcomes: The student will disassemble the assigned engine to level specified without damage to the engine, special tools, or himself according to manufacturers' recommended procedures.

3.0 INSPECTION PROCESSES

Instruction Goal: Know the types of inspection methods employed in turbine engine maintenance and how to employ these methods to the assigned engine components according to manufacturers' recommendations.

Defined Outcome The student will inspect assigned turbine engine components using approved methods in a consistent manner that will indicate the student can find known defects in test engine samples.

4.0 REPAIR

Instructional Goal Know approved field repair procedures for the assigned turbine engine.

Defined Outcome The student will blend a compressor blade and remove and replace bearings, seals and filters following manufacturers' recommendations.

A T 262L AIRCRAFT TURBINE ENGINE LABORATORY

5.0 ASSEMBLY

Instructional Goal Know the approved methods of assembly for the assembly of the assigned turbine engine components into a runable engine.

Defined Outcome The student will assemble the assigned engine according to manufacturers' directions and industry standards.

6.0 OPERATION AND TROUBLESHOOTING

Instructional Goal Know the correct methods of installing and running a turbine engine in an aircraft or a test cell. Know the most effective methods of troubleshooting simple engine or instrumentation problems.

Defined Outcome The student will install an assigned engine in the test cell or aircraft and test run the engine according to manufacturers' instructions. The student will troubleshoot engine problems based on data collected during a test run or from pilot information. The student will locate a sample trouble placed in the engine by the instructor using approved industry methods.

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A T 263 AIRCRAFT FLUID POWER SYSTEMS

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FAR 147 Appendix B (Gen)

Item	Level	
13	3	Fabricate and install rigid and flexible fluid lines and fittings.
17	3	Identify and select aircraft hardware and materials.

Appendix C (Airframe)

Item	Level	
29	3	Inspect, check, service, and repair landing gear, retraction systems, shock struts, brakes, wheels, tires, and steering systems.
30	2	Repair hydraulic and pneumatic power systems components.
31	3	Identify and select hydraulic fluids.
32	3	Inspect, troubleshoot, and repair hydraulic and pneumatic power systems.
45	2	Inspect and repair fluid quantity indicating systems.
47	2	Inspect, check, service, troubleshoot, and repair aircraft fuel systems.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Beginning with fluid power system, basics of pressure, force, area, volume, flow and speed, the student will be exposed to applications of fluid power to aircraft. Areas covered include fluids, seals, hoses, tubing, connections, and component identification, function, inspection, installation, and overhaul. System operation, inspection and troubleshooting are covered for hydraulic, pneumatic, and landing gear systems.

b. Credits: Students receive 3 credits for successful completion of this course.

c. Hours: The course is scheduled to meet 4 hours per week for fifteen weeks each semester (3600 min.) in class. In addition (4500 min.) outside work is expected for total student involvement of (8100 min).

d. The 58 hours of instruction accounts for two holidays and is devoted entirely to formal classroom presentations.

A T 263 AIRCRAFT FLUID POWER SYSTEMS

e. This course is required for completion of the Associate of Applied Science degree or Certificate program in Aviation Maintenance.

f. Lab fees: No lab fees.

g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations will precede preplanned, structured lab exercises that are presented in the accompanying laboratory course and allow the students to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance functions on hydraulic, pneumatic, and landing gear systems. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of math, physics, aviation publications, and aircraft hardware before entering this course. This working knowledge may be demonstrated in the following ways:

a. Passing the following courses or their equivalent, with a grade of "C" or better:

A T 160	Aircraft Information, Regulations and Procedures
A T 161	Aircraft Assembly
A T 161L	Aircraft Assembly Lab
Phys 110	Physics for Technicians

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record, or work history.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for make-up are outlined in Appendix B.

b. Class performance is evaluated by written or oral quizzes or tests and class participation.

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A T 263 AIRCRAFT FLUID POWER SYSTEMS

V. OUTLINE

1.0 Fluid Power Basics:
  1.1 History and types of fluid power.
  1.2 Mass, weight, density, specific gravity, force and work definitions.
  1.3 Pressure, force, area, relationships
  1.4 Volume, flow, speed relationships.
  1.5 Power, work, energy.
  1.6 Pressure drop, flow, resistance relationships.
  1.7 Compressibility, head, hydraulic lock definitions.

2.0 Fluids
  2.1 Types of fluids: gas, liquid.
  2.2 Fluid properties: viscosity, compressibility, specific gravity, chemical stability, lubrication properties, fire point, flash point, material compatibility, temperature range.
  2.3 Aircraft fluids: identification, properties, specifications, usage (vegetable base, petroleum base, phosphate ester base).

3.0 Seals
  3.1 Types of seals: gasket, packing.
  3.2 Seal design: gasket, packing (rotary) packing (linear), flat seals, O-rings, V-rings, cup seals, U-packings, special designs, (D-rings,, cam seals).
  3.3 Seal materials: metal, rubber (natural), rubber (synthetic - Buna N, neoprene, viton, butyl), teflon.
  3.4 Seal identification and usage: AN, MS, NAS (national aerospace specification), AS, (aero space), specfications, sizes, clearances, interchangeability, fluid compatibility, temperature range, and cross referencing.
  3.5 Seal installation, removal, storage, inspection, special tools.
  3.6 Seal accessories: back-up rings, forming blocks, wipers, universal nuts.

4.0 Fluid Lines, Rigid: Purpose, Desirable Characteristics.
  4.1 Materials: Al, CRESS, Cu (copper), Vinyl, Titanium.m.
  4.2 Construction: size, wall thickness, flow capacity, pressure.
  4.3 Identification, selection, inspection of aircraft tubing.
  4.4 Operations on aircraft tubing: cutting, bending, flaring, welding, annealing, repairs of dents and scratches.
  4.5 Fittings used to terminate aircraft tubing. flare (37° AN), flareless (MS), compression.
  4.6 Installation of tubing, bend radius and support.

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A T 263 AIRCRAFT FLUID POWER SYSTEMS

5.0 Fluid Lines: flexible
- 5.1 Purpose, desirable characteristics.
- 5.2 Construction size: low, med, high pressure; inner sleeves, layers, braiding outer sleeves, ID, O.D. work pressure, proof pressure, burst pressure.
- 5.3 Materials: rubber (synthetic, natural) teflon.
- 5.4 Identification, selection, inspection of aircraft hose: manufacturers' pressure, fluid compatibility and specifications.
- 5.5 Operations on aircraft hose: cutting, sleeving, skiving, installing fittings, inspecting and testing.
- 5.6 Removal and installation of hose: bend radius, supporting, flexing, storing of hoses.

6.0 Fittings for Fluid Connections
- 6.1 Purpose, desirable characteristics - seal, removable, reliable.
- 6.2 Construction: Pipe thread, screw thread, flare, flareless.
- 6.3 Material: Al, Cu, bronze, steel.
- 6.4 Sealing methods: pipe thread, O-ring, universal seal, flare, flareless, and crush washer.
- 6.5 Identification, selection, inspection of aircraft fittings.
- 6.6 Installation of fittings - in components, on fluid lines, positioning and torque.

7.0 Landing Gear Systems (Basic)
- 7.1 Loads on landing gear - weight, momentum: vertical, side loads, and drag loads.
- 7.2 Landing gear design - fixed and retractable.
- 7.3 Shock Absorbing: spring steel, bungee, rubber disk, oleo strut, laminates.
- 7.4 Special landing gear design: floats, skis, skids helicopters.
- 7.5 Landing gear configurations - conventional tricycle, fuselage and wingtip.
- 7.6 Identification of landing gear components: gear structure, attachments, bracing, actuators, locking mechanisms, axles, wheels, bearings, tires, brakes, fairings, steering mechanisms, shimmy dampers.
- 7.7 Inspection, operation, servicing and alignment of retractable gear with air oil shock strut.
- 7.8 Removal, installation, inspection and servicing of elastic shock cord type gear.
- 7.9 Removal, installation, inspection, servicing, and alignment of spring steel conventional gear.

8.0 Wheels, Tires and Bearings
- 8.1 Classes of tires.
- 8.2 Sizes of wheels, tires.
- 8.3 Removal, installation, inspection, repair and servicing of tires and tubes.

A T 263 AIRCRAFT FLUID POWER SYSTEMS

- 8.4 Types of bearings, description of bearings.
- 8.5 Removal, cleaning, inspection and installation of wheels and bearings.
- 8.6 Wheel bearing lubricants.

9.0 Aircraft Brakes - Unboosted
- 9.1 Types of brakes - drum, disc.
- 9.2 Brake actuation: mechanical, hydraulic-expander tube, hydraulic - drum and shoe, hydraulic, single and multiple disc.
- 9.3 Brake lining materials: organic, metallic and break-in brake installation.
- 9.4 Hydraulic brake system components: master cylinder, reservoir, fluid lines, wheel cylinder, disc, bleed valve, parking valve, compensating port, pedal linkage.
- 9.5 Removal, inspection, repair, servicing, installation of hydraulic brake systems and components.

10.0 Aircraft Brakes - Boosted
- 10.1 Boosted brake system components: hydraulic power source, metering valve, anti-skid valve, debooster cylinder, actuators, rotors, stators, torque tubes, wheels.
- 10.2 Metering valve operation: fluid flow, force feedback.
- 10.3 Debooster cylinder operation.
- 10.4 Anti-skid system components and operation: wheel speed transducer, skid computer, electro-hydraulic servo valve operation, antiskid valve operation, self test.
- 10.5 Removal, inspection, servicing, installation of power boosted, multiple disc brakes.

11.0 Aircraft Hydraulic Pumps
- 11.1 Pump basics - pressure vs resistance to flow. Flow vs displacement and RPM. power input requirements.
- 11.2 Pump Types - Positive displacement: gear, vane, Piston, gearotor and their flows and pressure, ranges.
  - Non-Positive displacement: centrifugal, diaphragm.
- 11.3 Fixed and variable delivery pumps, variable delivery methods: wobble plate, intake starvation, pressure demand, bent axis.
- 11.4 Pump failures: contamination, heat, cavitation, seizure.
- 11.5 Pump overhaul procedures: (major repairs).
- 11.6 Disassembly, inspection, parts identification and reassembly of piston and gear pumps.

12.0 Regulators
- 12.1 Pressure regulation through flow diversion.
- 12.2 Single, dual, and triple-stage pressure regulators.
- 12.3 Pump unloading.
- 12.4 Troubleshooting aircraft pressure regulators.

A T 263 AIRCRAFT FLUID POWER SYSTEMS

13.0 Aircraft Hydraulic Reservoirs
- 13.1 Design features: filler, filter, outlets, return, quantity gauge, baffles, heat dissipation, pressurization, capacity.
- 13.2 Types of pressurization: vented, bleed air pressure, reduced system pressure.
- 13.3 Servicing hydraulic reservoirs.

14.0 Aircraft Hydraulic Filters
- 14.1 Filter construction: head, bowl, element.
- 14.2 Element types and ratings: wire screen, paper (micronic), cuno, stacked disks, fused metal.
- 14.3 Filter features: fluid flow, pressure drop, by pass valve, magnetic plugs, differential press indicator.
- 14.4 Filter placement: case drain, pump supply, pressure line, servo valves, reservoir vents, return line.
- 14.5 Filter servicing: removal, inspection, replacement.

15.0 Aircraft hydraulic accumulators
- 15.1 Uses of accumulator: shock absorbing, added flow during high demand.
- 15.2 Accumulator design: sphere and diaphram, cylinder and piston.
- 15.3 Accumulator features: fluid line connection, fluid/air separator and seals, air pressure gauge, air servicing valve.
- 15.4 Servicing of accumulators.
- 15.5 Trouble-shooting accumulators using flight deck system indications.

16.0 Control Valves
- 16.1 Uses of control valves: direct or block flow to and/or from pump and or tank actuator extend, actuator retract.
- 16.2 Valve construction: poppet, spool, rotary.
- 16.3 Types of valves: open/closed center, open/closed port.
- 16.4 Valves in a system: In series with each other, in parallel with each other.
- 16.5 Mechanical feedback to control valves: position Feedback - flight controls: force feedback - brakes.
- 16.6 Summing levers and floating actuators.
- 16.7 Valve operation and troubleshooting.
- 16.8 Electro-hydraulic servo valves.

17.0 Actuators
- 17.1 Actuator principles: force, pressure, area, flow volume, speed, stroke.
- 17.2 Resolution of forces in levers, bell cranks and quadrants.
- 17.3 Actuator construction, one way, two way, linear, rotary, port arrangements, seals and wipers, materials.
- 17.4 Disassembly, seal replacement, inspection and reassembly of actuators..
- 17.5 Trouble-shooting actuators.

A T 263 AIRCRAFT FLUID POWER SYSTEMS

18.0 Miscellaneous Hydraulic Components
- 18.1 Check valves.
- 18.2 Hydraulic fuse.
- 18.3 Oriface restrictions.
- 18.4 One-way restrictions.
- 18.5 Pressure gauge.
- 18.6 Relief valves.
- 18.7 Purge valves.
- 18.8 Pressure reducing valves.
- 18.9 Priority valve.
- 18.10 Sequence valves.

19.0 Hydraulic Systems
- 19.1 Demand systems
- 19.2 Full-time systems
- 19.3 Multiple systems

20.0 Pneumatic Systems
- 20.1 Pneumatic differences: compressible fluid, no hydraulic lock, no return lines, no reservoir, vapor elimination, lubrication.
- 20.2 Pneumatic power system examples: F-27, B-747, B-767.
- 20.3 Pneumatic power sources: engine driven compressor, bleed air, electric motor driven compressor.
- 20.4 Uses of pneumatic power: gear retract, drive hydraulic pump, L.E. device deployment.
- 20.5 Trouble-shooting pneumatic power system.

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 FLUID POWER BASICS

Instructional Goal: Know the reasons for use of fluid power systems on aircraft, the history of their use, and the physical relationships that allow description and prediction of their operation.

Defined Outcomes: The student will describe the history of fluid power usage on aircraft, define the factors involved in fluid power operations (e.g. pressure, force, density, flow, etc.) and given enough information, accurately predict (calculate) unknown factors for fluid power systems.

2.0 FLUIDS

Instructional Goal: Identify hydraulic fluids, their general composition and chemical properties and select the proper fluid for use in aircraft systems.

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Defined Outcomes: The student will identify fluids and select the proper fluid for replenishment for fluid power systems on several aircraft.

3.0 SEALS

Instructional Goals: Know the types of seals used in fluid power systems; their design: shape, dimensions, material; properties: elasticity, resiliance, hardness, fluid compatibility.

Defined Outcomes: The student will describe fluid power seal designs, use manufacturers' data to select correct seals by part number and cross reference part numbers between AN, MS, NAS, AS and manufacturers' specifications.

Instructional Goal: Know the uses of different types of seals and seal designs, the accessories that make up a sealing system and the proper removal, inspection and installation techniques for seals.

Defined Outcomes: The student will remove, inspect, replace and properly reinstall seals and seal accessories on aircraft components.

4.0 FLUID LINES: RIGID

Instructional Goals: Know sizes, material, construction and fabrication techniques for aircraft rigid fluid lines.

Defined Outcomes: The student will describe, plan and complete rigid fluid line fabrication and installation, connecting to aircraft components.

5.0 FLUID LINES: FLEXIBLE

Instructional Goal: Know size, material, construction and fabrication techniques for aircraft flexible fluid lines of various pressures and sizes.

Defined Outcomes: Student will describe, plan and complete flexible fluid line fabrication and installation projects on aircraft components.

6.0 FITTINGS FOR FLUID CONNECTIONS

Instructional Goal: Recognize fittings used for pipethread, boss, universal, flare and flareless connections and selection and assembly techniques for those fittings.

Defined Outcomes: The student will select fittings for size and type connection and complete an assembly that properly connects hydraulic lines to aircraft components.

A T 263 AIRCRAFT FLUID POWER SYSTEMS

7.0 LANDING GEAR SYSTEMS

Instructional Goal: Recognize and understand the design and function of common types of landing gear.

Defined Outcomes: The student will describe or identify each common type of landing gear and describe the function of each component.

Instructional Goal: Understand removal, inspection, and replacement techniques for typical landing gear types based on manufacturers' information.

Defined Outcomes: The student will remove, inspect, and properly reinstall typical landing gear types using available manufacturers' instructions.

Instructional Goal: Know proper servicing techniques for retractable landing gear systems including fluid servicing, lubrication, parts replacement, alignment and adjustment of moving parts.

Defined Outcomes: The student will describe and perform required servicing on typical retractable landing gear systems in accordance with manufacturers' instructions.

8.0 WHEELS, TIRES, BEARINGS

Instructional Goals: Know classes of tires, types of wheels and bearings, and inspections and servicing procedures for each.

Defined Outcomes: The student will describe and identify types of tires and wheels and properly perform removal, inspection, servicing, and installation of wheels, tires and bearings.

9.0 AIRCRAFT BRAKES: UNBOOSTED

Instructional Goals: Know brake designs, features, and system operation. Identify brake system components and understand their function and inspection and servicing requirements.

Defined Outcomes: The student will describe aircraft brake systems, identify components and describe their function properly remove, inspect, service, install, bleed and test all moving components on an aircraft brake system.

10.0 AIRCRAFT BRAKES: BOOSTED

Instructional Goals: Know boosted brake system design features, and operation. Identify system components and understand their function and inspection and servicing requirements.

Defined Outcomes: The student will identify and describe the function of boosted brake system components. Using aircraft components or mock-ups and manufacturers' data the student will isolate brake problems and probable solutions to those problems.

11.0 AIRCRAFT HYDRAULIC PUMPS

Instructional Goals: Know the types (gear, vane, piston) and classifications of fluid pumps (positive/non-positive displacement, fixed/variable delivery) method of operation, function of internal parts, maintenance requirements, and techniques for troubleshooting pump problems.

Defined Outcomes: Students will describe pump operation for different pump types, identify parts, describe overhaul procedures and demonstrate disassembly and reassembly techniques for typical aircraft fluid power pumps.

12.0 REGULATORS

Instructional Goals: Know internal operation of typical multistage pressure regulators and unloading valves, their use in a hydraulic system, servicing requirements and troubleshooting techniques.

Defined Outcomes: Students will describe multistage regulator operation using manufacturers' data or dynamic models, describe their use in a fluid power system and determine what system problems are likely attributable to regulators.

13.0 AIRCRAFT HYDRAULIC RESERVOIRS

Instructional Goals: Know design features, operation and servicing of hydraulic fluid reservoirs.

Defined Outcomes: Students will describe and identify reservoir features including fill ports, level indicators, outlet and return ports, filtering, pressurization or vent ports and heat transfer mechanisms. In addition, students must calculate reservoir capacity and determine level fluctuations caused by system actuation and service a hydraulic reservoir.

14.0 AIRCRAFT HYDRAULIC FILTERS

Instructional Goals: Know design features, operation and servicing of fluid power system filters.

Defined Outcomes: Students will describe fluid flow through filters, filtration capabilities, filter components, types of filter elements and filter inspection techniques. Students will properly remove, inspect, replace and reinstall filters in hydraulic systems.

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15.0 AIRCRAFT HYDRAULIC ACCUMULATORS

Instructional Goals: Know design features, operation and servicing of accumulators for fluid power systems.

Defined Outcomes: Students will describe construction and operation of accumulators under various conditions of system pressure and flow. Students will inspect and service an aircraft hydraulic accumulator for leakage, air precharge, housing, separator and valve condition.

16.0 HYDRAULIC CONTROL VALVES

Instructional Goals: Know the most common methods of providing hydraulic fluid controls with poppet, spool and rotary valves using open or closed centers and open or closed ports.

Defined Outcomes: Students will describe construction and operation of various types of typical valves of differing design. Students will install valves in a system, adjust linkage and operate system components with those valves.

Instructional Goals: Know the systems that require feedback to the control valve, the type of feedback required, (position or force) and how the feedback is provided.

Defined Outcomes: The student will identify internal porting and mechanical connections that provide position and force feedback from actuators to control valves. Students will connect, and test actuator/valve combinations that incorporate position or force feedback.

Instructional Goals: Know the operation and control of a dual stage electro-hydraulic servo valve (EHSV) using a jet pipe or a flapper control.

Defined Outcomes: Student will identify EHSV's on hydraulic components or diagrams and describe or demonstrate their operation.

17.0 ACTUATORS

Instructional Goals: Know the direction of actuation, force and stroke available from an aircraft hydraulic actuator. Identify acuator components, perform inspection, troubleshooting and servicing of hydraulic activators.

Defined Outcomes: Students will describe the operation of an actuator in a system, remove, inspect, service e.g. change seals, hone, etc. reinstall and test the operation of the actuator.

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18.0 MISCELLANEOUS HYDRAULIC COMPONENTS

Instructional Goals: Know the purpose and operation of the listed hydraulic components.

Defined Outcomes: Students will identify the components on an aircraft or drawing, describe their operation and their purpose in the system.

19.0 HYDRAULIC SYSTEMS

Instructional Goal Know the types of hydraulic systems used on aircraft, their capabilities and component relationships.

Defined Outcomes The student will describe the operation of hydraulic systems on various aircraft.

20.0 PNEUMATIC SYSTEMS

Instructional Goals: Know how pneumatic systems differ from hydraulic systems, identify pneumatic systems used on various aircraft, their components and their operation.

Defined Outcomes: The student will describe the operation of pneumatic systems on various aircraft, identifying important components and list servicing requirements for each system.

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A T 263L AIRCRAFT FLUID POWER SYSTEMS LABORATORY

FAR 147 Appendix B (Gen)

Item	Level	
13	3	Fabricate and install rigid and flexible fluid lines and fittings.
17	3	Identify and select aircraft hardware and materials.
		Appendix C (Airframe)
29	3	Inspect, check, service, and repair landing gear, retraction systems, shock struts, brakes, wheels, tires, and steering systems.
30	2	Repair hydraulic and pneumatic power systems components.
31	3	Identify and select hydraulic fluids.
32	3	Inspect, troubleshoot, and repair hydraulic and pneumatic power systems.
45	2	Inspect and repair fluid quantity indicating systems.
47	2	Inspect, check, service, troubleshoot, and repair aircraft fuel systems.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Beginning with fluid power system, basics of pressure, force, area, volume, flow and speed, the student will be exposed to applications of fluid power to aircraft. Areas covered include fluids, seals, hoses, tubing, connections, and component identification, function, inspection, installation, and overhaul. System operation, inspection, and troubleshooting are covered for hydraulic, pneumatic, and landing gear systems.

b. Credits: Students receive 2 credits for successful completion of this course.

c. Hours: The course is scheduled to meet 6 hours per week for fifteen weeks each semester (5400 min.) in class, which is total student involvement.

d. The 87 hours of instruction accounts for two holidays and is devoted entirely to laboratory and shop exercises.

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e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab Fees: Lab fees for this course are outlined in Appendix A.

g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations will precede preplanned, structured lab exercises that are presented in the accompanying lecture course and allow the students to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance functions on hydraulic, pneumatic, and landing gear systems. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of math, physics, aviation publications, and aircraft hardware before entering this course. This working knowledge may be demonstrated in the following ways:

a. Passing the following courses or their equivalent, with a grade of "C" or better:

A T 160	Aircraft Information, Regulations and Procedures
A T 161	Aircraft Assembly
A T 161L	Aircraft Assembly Lab
Phys 110	Physics for Technicians

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record, or work history.

c. This course must be taken concurrently with AT 263 lecture course.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for make-up are outlined in Appendix B.

b. Class performance is evaluated by written or oral quizzes or tests and class participation.

e. Final grades for students are computed by averaging marks for participation and lab technique on assigned projects. This includes research of documentation, project planning, use of tools, safety, efficiency, thoroughness, and records of project results.

V. OUTLINE

1.0 Fluid Power Basics:
  1.1 History and types of fluid power.
  1.2 Mass, weight, density, specific gravity, force and work definitions.
  1.3 Pressure, force, area, relationships
  1.4 Volume, flow, speed relationships.
  1.5 Power, work, energy.
  1.6 Pressure drop, flow, resistance relationships.
  1.7 Compressibility, head, hydraulic lock definitions.

2.0 Fluids
  2.1 Types of fluids: gas, liquid.
  2.2 Fluid properties: viscosity, compressibility, specific gravity, chemical stability, lubrication properties, fire point, flash point, material compatibility, temperature range.
  2.3 Aircraft fluids: identification, properties, specifications, usage (vegetable base, petroleum base, phosphate ester base).

3.0 Seals
  3.1 Types of seals: gasket, packing.
  3.2 Seal design: gasket, packing (rotary) packing (linear), flat seals, O-rings, V-rings, cup seals, U-packings, special designs, (D-rings,, cam seals).
  3.3 Seal materials: metal, rubber (natural), rubber (synthetic - Buna N, neoprene, viton, butyl), teflon.
  3.4 Seal identification and usage: AN, MS, NAS (national aerospace specification), AS, (aero space), specfications, sizes, clearances, interchangeability, fluid compatibility, temperature range, and cross referencing.
  3.5 Seal installation, removal, storage, inspection, special tools.
  3.6 Seal accessories: back-up rings, forming blocks, wipers, universal nuts.

4.0 Fluid Lines, Rigid: Purpose, Desirable Characteristics.
  4.1 Materials: Al, CRESS, Cu (copper), Vinyl, Titanium.m.
  4.2 Construction: size, wall thickness, flow capacity, pressure.
  4.3 Identification, selection, inspection of aircraft tubing.

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- 4.4 Operations on aircraft tubing: cutting, bending, flaring, welding, annealing, repairs of dents and scratches.
- 4.5 Fittings used to terminate aircraft tubing. flare (37° AN), flareless (MS), compression.
- 4.6 Installation of tubing, bend radius and support.

5.0 Fluid Lines: flexible
- 5.1 Purpose, desirable characteristics.
- 5.2 Construction size: low, med, high pressure; inner sleeves, layers, braiding outer sleeves, ID, O.D. work pressure, proof pressure, burst pressure.
- 5.3 Materials: rubber (synthetic, natural) teflon.
- 5.4 Identification, selection, inspection of aircraft hose: manufacturers' pressure, fluid compatibility and specifications.
- 5.5 Operations on aircraft hose: cutting, sleeving, skiving, installing fittings, inspecting and testing.
- 5.6 Removal and installation of hose: bend radius, supporting, flexing, storing of hoses.

6.0 Fittings for Fluid Connections
- 6.1 Purpose, desirable characteristics - seal, removable, reliable.
- 6.2 Construction: Pipe thread, screw thread, flare, flareless.
- 6.3 Material: Al, Cu, bronze, steel.
- 6.4 Sealing methods: pipe thread, O-ring, universal seal, flare, flareless, and crush washer.
- 6.5 Identification, selection, inspection of aircraft fittings.
- 6.6 Installation of fittings - in components, on fluid lines, positioning and torque.

7.0 Landing Gear Systems (Basic)
- 7.1 Loads on landing gear - weight, momentum: vertical, side loads, and drag loads.
- 7.2 Landing gear design - fixed and retractable.
- 7.3 Shock Absorbing: spring steel, bungee, rubber disk, oleo strut, laminates.
- 7.4 Special landing gear design: floats, skis, skids helicopters.
- 7.5 Landing gear configurations - conventional tricycle, fuselage and wingtip.
- 7.6 Identification of landing gear components: gear structure, attachments, bracing, actuators, locking mechanisms, axles, wheels, bearings, tires, brakes, fairings, steering mechanisms, shimmy dampers.
- 7.7 Inspection, operation, servicing and alignment of retractable gear with air oil shock strut.
- 7.8 Removal, installation, inspection and servicing of elastic shock cord type gear.

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7.9 Removal, installation, inspection, servicing, and alignment of spring steel conventional gear.

8.0 Wheels, Tires and Bearings
  8.1 Classes of tires.
  8.2 Sizes of wheels, tires.
  8.3 Removal, installation, inspection, repair and servicing of tires and tubes.
  8.4 Types of bearings, description of bearings.
  8.5 Removal, cleaning, inspection and installation of wheels and bearings.
  8.6 Wheel bearing lubricants.

9.0 Aircraft Brakes - Unboosted
  9.1 Types of brakes - drum, disc.
  9.2 Brake actuation: mechanical, hydraulic-expander tube, hydraulic - drum and shoe, hydraulic, single and multiple disc.
  9.3 Brake lining materials: organic, metallic and break-in brake installation.
  9.4 Hydraulic brake system components: master cylinder, reservoir, fluid lines, wheel cylinder, disc, bleed valve, parking valve, compensating port, pedal linkage.
  9.5 Removal, inspection, repair, servicing, installation of hydraulic brake systems and components.

10.0 Aircraft Brakes - Boosted
  10.1 Boosted brake system components: hydraulic power source, metering valve, anti-skid valve, debooster cylinder, actuators, rotors, stators, torque tubes, wheels.
  10.2 Metering valve operation: fluid flow, force feedback.
  10.3 Debooster cylinder operation.
  10.4 Anti-skid system components and operation: wheel speed transducer, skid computer, electro-hydraulic servo valve operation, anti-skid valve operation, self-test.
  10.5 Removal, inspection, servicing, installation of power boosted, multiple disc brakes.

11.0 Aircraft Hydraulic Pumps
  11.1 Pump basics - pressure vs resistance to flow. Flow vs displacement and RPM. power input requirements.
  11.2 Pump Types - Positive displacement: gear, vane, Piston, gearotor and their flows and pressure, ranges.
  - Non-Positive displacement: centrifugal, diaphragm.
  11.3 Fixed and variable delivery pumps, variable delivery methods: wobble plate, intake starvation, pressure demand, bent axis.
  11.4 Pump failures: contamination, heat, cavitation, seizure.
  11.5 Pump overhaul procedures: (major repairs).
  11.6 Disassembly, inspection, parts identification and reassembly of piston and gear pumps.

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12.0 Regulators
- 12.1 Pressure regulation through flow diversion.
- 12.2 Single, dual, and triple-stage pressure regulators.
- 12.3 Pump unloading.
- 12.4 Troubleshooting aircraft pressure regulators.

13.0 Aircraft Hydraulic Reservoirs
- 13.1 Design features: filler, filter, outlets, return, quantity gauge, baffles, heat dissipation, pressurization, capacity.
- 13.2 Types of pressurization: vented, bleed air pressure, reduced system pressure.
- 13.3 Servicing hydraulic reservoirs.

14.0 Aircraft Hydraulic Filters
- 14.1 Filter construction: head, bowl, element.
- 14.2 Element types and ratings: wire screen, paper (micronic), cuno, stacked disks, fused metal.
- 14.3 Filter features: fluid flow, pressure drop, by-pass valve, magnetic plugs, differential press indicator.
- 14.4 Filter placement: case drain, pump supply, pressure line, servo valves, reservoir vents, return line.
- 14.5 Filter servicing: removal, inspection, replacement.

15.0 Aircraft hydraulic accumulators
- 15.1 Uses of accumulator: shock absorbing, added flow during high demand.
- 15.2 Accumulator design: sphere and diaphragm, cylinder and piston.
- 15.3 Accumulator features: fluid line connection, fluid/air separator and seals, air pressure gauge, air servicing valve.
- 15.4 Servicing of accumulators.
- 15.5 Trouble-shooting accumulators using flight deck system indications.

16.0 Control Valves
- 16.1 Uses of control valves: direct or block flow to and/or from pump and or tank actuator extend, actuator retract.
- 16.2 Valve construction: poppet, spool, rotary.
- 16.3 Types of valves: open/closed center, open/closed port.
- 16.4 Valves in a system: In series with each other, in parallel with each other.
- 16.5 Mechanical feedback to control valves: position Feedback - flight controls: force feedback - brakes.
- 16.6 Summing levers and floating actuators.
- 16.7 Valve operation and troubleshooting.
- 16.8 Electro-hydraulic servo valves.

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17.0 Actuators
- 17.1 Actuator principles: force, pressure, area, flow volume, speed, stroke.
- 17.2 Resolution of forces in levers, bell cranks and quadrants.
- 17.3 Actuator construction, one way, two way, linear, rotary, port arrangements, seals and wipers, materials.
- 17.4 Disassembly, seal replacement, inspection and reassembly of actuators..
- 17.5 Trouble-shooting actuators.

18.0 Miscellaneous Hydraulic Components
- 18.1 Check valves.
- 18.2 Hydraulic fuse.
- 18.3 Oriface restrictions.
- 18.4 One-way restrictions.
- 18.5 Pressure gauge.
- 18.6 Relief valves.
- 18.7 Purge valves.
- 18.8 Pressure reducing valves.
- 18.9 Priority valve.
- 18.10 Sequence valves.

19.0 Hydraulic Systems
- 19.1 Demand systems
- 19.2 Full-time systems
- 19.3 Multiple systems

20.0 Pneumatic Systems
- 20.1 Pneumatic differences: compressible fluid, no hydraulic lock, no return lines, no reservoir, vapor elimination, lubrication.
- 20.2 Pneumatic power system examples: F-27, B-747, B-767.
- 20.3 Pneumatic power sources: engine driven compressor, bleed air, electric motor driven compressor.
- 20.4 Uses of pneumatic power: gear retract, drive hydraulic pump, L.E. device deployment.
- 20.5 Trouble-shooting pneumatic power system.

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 FLUID POWER BASICS

Instructional Goal: Know the reasons for use of fluid power systems on aircraft, the history of their use, and the physical relationships that allow description and prediction of their operation.

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Defined Outcomes: The student will describe the history of fluid power usage on aircraft, define the factors involved in fluid power operations (e.g. pressure, force, density, flow, etc.) and given enough information, accurately predict (calculate) unknown factors for fluid power systems.

2.0 FLUIDS

Instructional Goal: Identify hydraulic fluids, their general composition and chemical properties and select the proper fluid for use in aircraft systems.

Defined Outcomes: The student will properly identify fluids and select the proper fluid for replenishment for fluid power systems on several aircraft.

3.0 SEALS

Instructional Goals: Know the types of seals used in fluid power systems; their design: shape, dimensions, material; properties: elasticity, resiliance, hardness, fluid compatibility.

Defined Outcomes: The student will describe fluid power seal designs, use manufacturers' data to select correct seals by part number and cross reference part numbers between AN, MS, NAS, AS and manufacturers' specifications.

Instructional Goal: Know the uses of different types of seals and seal designs, the accessories that make up a sealing system and the proper removal, inspection and installation techniques for seals.

Defined Outcomes: The student will remove, inspect, replace and properly reinstall seals and seal accessories on aircraft components.

4.0 FLUID LINES: RIGID

Instructional Goals: Know sizes, material, construction and fabrication techniques for aircraft rigid fluid lines.

Defined Outcomes: The student will describe, plan and complete rigid fluid line fabrication and installation, connecting to aircraft components.

5.0 FLUID LINES: FLEXIBLE

Instructional Goal: Know size, material, construction and fabrication techniques for aircraft flexible fluid lines of various pressures and sizes.

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Defined Outcomes: Student will describe, plan and complete flexible fluid line fabrication and installation projects on aircraft components.

6.0 FITTINGS FOR FLUID CONNECTIONS

Instructional Goal: Recognize fittings used for pipethread, boss, universal, flare and flareless connections and selection and assembly techniques for those fittings.

Defined Outcomes: The student will properly select fittings for size and type connection and complete an assembly that properly connects hydraulic lines to aircraft components.

7.0 LANDING GEAR SYSTEMS

Instructional Goal: Recognize and understand the design and function of common types of landing gear.

Defined Outcomes: The student will describe or identify each common type of landing gear and describe the function of each component.

Instructional Goal: Understand removal, inspection, and replacement techniques for typical landing gear types based on manufacturers' information.

Defined Outcomes: The student will remove, inspect, and properly reinstall typical landing gear types using available manufacturers' instructions.

Instructional Goal: Know proper servicing techniques for retractable landing gear systems including fluid servicing, lubrication, parts replacement, alignment and adjustment of moving parts.

Defined Outcomes: The student will properly describe and perform required servicing on typical retractable landing gear systems in accordance with manufacturers' instructions.

8.0 WHEELS, TIRES, BEARINGS

Instructional Goals: Know classes of tires, types of wheels and bearings, and inspections and servicing procedures for each.

Defined Outcomes: The student will describe and identify types of tires and wheels and properly perform removal, inspection, servicing, and installation of wheels, tires and bearings.

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9.0 AIRCRAFT BRAKES: UNBOOSTED

Instructional Goals: Know brake designs, features, and system operation. Identify brake system components and understand their function and inspection and servicing requirements.

Defined Outcomes: The student will describe aircraft brake systems, identify components and describe their function, properly remove, inspect, service, install, bleed and test all moving components on an aircraft brake system.

10.0 AIRCRAFT BRAKES: BOOSTED

Instructional Goals: Know boosted brake system design features, and operation. Identify system components and understand their function and inspection and servicing requirements.

Defined Outcomes: The student will identify and describe the function of boosted brake system components. Using aircraft components or mock-ups and manufacturers' data the student will isolate brake problems and probable solutions to those problems.

11.0 AIRCRAFT HYDRAULIC PUMPS

Instructional Goals: Know the types (gear, vane, piston) and classifications of fluid pumps (positive/non-positive displacement, fixed/variable delivery) method of operation, function of internal parts, maintenance requirements, and techniques for troubleshooting pump problems.

Defined Outcomes: Students will accurately describe pump operation for different pump types, identify parts, describe overhaul procedures and demonstrate disassembly and reassembly techniques for typical aircraft fluid power pumps.

12.0 REGULATORS

Instructional Goals: Know internal operation of typical multistage pressure regulators and unloading valves, their use in a hydraulic system, servicing requirements and troubleshooting techniques.

Defined Outcomes: Students will describe multistage regulator operation using manufacturers' data or dynamic models, describe their use in a fluid power system and determine what system problems are likely attributable to regulators.

13.0 AIRCRAFT HYDRAULIC RESERVOIRS

Instructional Goals: Know design features, operation and servicing of hydraulic fluid reservoirs.

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Defined Outcomes: Students will describe and identify reservoir features including fill ports, level indicators, outlet and return ports, filtering, pressurization or vent ports and heat transfer mechanisms. In addition, students must calculate reservoir capacity and determine level fluctuations caused by system actuation and service a hydraulic reservoir.

14.0 AIRCRAFT HYDRAULIC FILTERS

Instructional Goals: Know design features, operation and servicing of fluid power system filters.

Defined Outcomes: Students will describe fluid flow through filters, filtration capabilities, filter components, types of filter elements and filter inspection techniques. Students will properly remove, inspect, replace and reinstall filters in hydraulic systems.

15.0 AIRCRAFT HYDRAULIC ACCUMULATORS

Instructional Goals: Know design features, operation and servicing of accumulators for fluid power systems.

Defined Outcomes: Students will describe construction and operation of accumulators under various conditions of system pressure and flow. Students will inspect and service an aircraft hydraulic accumulator for leakage, air precharge, housing, separator and valve condition.

16.0 HYDRAULIC CONTROL VALVES

Instructional Goals: Know the most common methods of providing hydraulic fluid controls with poppet, spool and rotary valves using open or closed centers and open or closed ports.

Defined Outcomes: Students will describe construction and operation of various types of typical valves of differing design. Students will install valves in a system, adjust linkage and operate system components with those valves.

Instructional Goals: Know the systems that require feedback to the control valve, the type of feedback required, (position or force) and how the feedback is provided.

Defined Outcomes: The student will identify internal porting and mechanical connections that provide position and force feedback from actuators to control valves. Students will connect, and test actuator/valve combinations that incorporate position or force feedback.

Instructional Goals: Know the operation and control of a dual stage electro-hydraulic servo valve (EHSV) using a jet pipe or a flapper control.

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Defined Outcomes: Student will identify EHSV's on hydraulic components or diagrams and describe or demonstrate their operation.

17.0 ACTUATORS

Instructional Goals: Know the direction of actuation, force and stroke available from an aircraft hydraulic actuator. Identify actuator components, perform inspection, troubleshooting and servicing of hydraulic activators.

Defined Outcomes: Students will describe the operation of an actuator in a system, remove, inspect, service e.g. change seals, hone, etc. reinstall and test the operation of the actuator.

18.0 MISCELLANEOUS HYDRAULIC COMPONENTS

Instructional Goals: Know the purpose and operation of the listed hydraulic components.

Defined Outcomes: Students will identify the components on an aircraft or drawing, describe their operation and their purpose in the system.

19.0 HYDRAULIC SYSTEMS

Instructional Goal Know the types of hydraulic systems used on aircraft, their capabilities and component relationships.

Defined Outcomes The student will describe the operation of hydraulic systems on various aircraft.

20.0 PNEUMATIC SYSTEMS

Instructional Goals: Know how pneumatic systems differ from hydraulic systems, identify pneumatic systems used on various aircraft, their components and their operation.

Defined Outcomes: The student will describe the operation of pneumatic systems on various aircraft, identifying important components and list servicing requirements for each system.

VII. PROJECTS

0.0 Safety

Students will know and demonstrate proper procedures for dealing with powered machinery, high pressure fluids, aircraft on jacks, powered actuators.

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Level

1.0 Basic Fluid Power

2 1.1 Hydraulic test stand: basic system setup of pump, manifold, flow gauge, pressure indicator, valves, actuators, loads. Observe and report pressure flow, speed, force relationships for several different combinations of actuators, loads and system pressures.

2.0 Fluids

2.1 Identify fluids by color.

3 2.2 Research and report on types of fluids used, their specifications (mil or industry) and the quantities used for hydraulic system for 3 different aircraft (large, medium, small -e.g. B-737, Beech KA 200, PA-31, Cessna 185).

3.0 Seals

3 3.1 Remove and replace seals and accessories with proper part number on assigned hydraulic components and connections.

3.2 Fabricate seal removal and installation tools from soft material for use on steel hydraulic components (eg. brass, aluminum, plastic, or fiberglass tools).

4.0 Rigid Lines

3 4.1 Fabricate rigid line installations using annealed tubing that demonstrate understanding and skill in the following operations: line selection, cutting, bending, flaring (single and double) routing, supporting, protecting, repairing and inspecting.

5.0 Flex Hose

3 5.1 Fabricate two flexible hoses for hydraulic applications from medium pressure hose, one from rubber hose, one from teflon hose. Demonstrate acceptable knowledge and skill level in the following operations: Selection, cutting, fitting, installation, connecting, routing, supporting, protection, repair, inspection.

6.0 Fittings for fluid connections:

3 6.1 On an aircraft or a system mock-up, select and install the correct fittings to connect a given hose or rigid line to a given component demonstrating the following operations: fitting selection, lubrication, position, torqueing, inspection and testing.

7.0 Landing Gear:

3 7.1 Sling airplane, remove, inspect all components and attachments, and reinstall elastic shock cord type landing gear.

7.2 Sling airplane, remove, inspect all components and attachments and reinstall and align spring steel conventional landing gear.

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7.3 Remove, disassemble, inspect, reassemble and reinstall a steerable tail wheel assembly.

7.4 Jack airplane, inspect and service retractable, oleo type landing gear system to include: retraction test, oleo air and oil servicing, retraction system lubrication, anti-retraction device and position switch adjustment.

8.0 Wheels, Tires, and Bearings

3 8.1 Jack airplane, remove wheel. Disassemble tire, wheel halves, bearings and races. Inspect (visual and NDT as required) the wheel halves, bearings, tires and tube. Lubricate, reassemble, and install assembly.

9.0 Aircraft Brakes - Unboosted

3 9.1 Remove and disassemble master cylinder and wheel cylinder of disc type brake system. Inspect, replace seals, hone cylinders and replace linings as necessary. Reassemble, reinstall, bleed and test assembly.

10.0 Aircraft Brakes - Boosted

1 Projects and demonstrations as available and applicable.

11.0 Aircraft Hydraulic Pumps

2 11.1 Disassemble, identify parts, inspect, dimensionally check as appropriate, reassemble and test one each of the following type hydraulic or pneumatic pumps:

a. Gear
b. Vane
c. Piston - Fixed Delivery
d. Piston - Variable Delivery

12.0 Regulators

2 12.1 Adjust regulated system hydraulic pressure.

13.0 Reservoirs

3 13.1 Inspect and service reservoir. Include the following items: fill port and filter, quantity indicator, outlet filter (if installed) fluid type and quantity reservoir pressurization.

14.0 Filters

3 14.1 Remove, inspect and clean or replace and reinstall fluid filter.

15.0 Accumulators

3 15.1 Check accumulator for leaky diaphragm and air precharge. Service accumulator with air.

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16.0 Control Valves

2 16.1 On aircraft or test bench properly connect fluid lines to four-way control valve to control a hydraulic actuator.

17.0 Actuators

2 17.1 Disassemble, inspect, replace seals, reassemble and test a linear hydraulic actuator.

18.0 Miscellaneous Components

1 18.1 Identify components.

19.0 Hydraulic Systems

2 19.1 Check hydraulic system for proper operation.

20.0 Pneumatic Systems

1 20.1 Identify components and describe their use.

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A T 264 AIRCRAFT ELECTRICAL SYSTEMS

FAR 147 Appendix B (General)

Item	Level	
5	3	Read and interpret electrical circuit diagrams.

Appendix C (Airframe)

Item	Level	
36	1	Inspect, check, service, troubleshoot and repair heading, speed, altitude, time, attitude, temperature, pressure and position indicating systems.
37	2	Install instruments.
38	1	Inspect, check, and service auto-pilot and approach control systems.
39	1	Inspect, check, and service aircraft electronic communication and navigation systems.
40	2	Inspect and repair antenna and electronic equipment installations.
45	2	Inspect and Repair Fluid Quantity Indicator Systems.
46	2	Troubleshoot, service, and repair fluid pressure and temperature warning systems.
48	2	Repair aircraft electrical system components.
49	3	Install, check, and service airframe, electrical wiring, controls, switches, indicators, and protective devices.

Appendix D (Powerplant)

Item	Level	
9	2	Troubleshoot, service, and repair fluid rate-of-flow indicating systems.
10	3	Inspect, check, service, troubleshoot, and repair engine temperature, pressure, and r.p.m. indicating systems.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: This course builds on previous course coverage of AC and DC electrical power generation, control and distribution in an airborne environment. Uses of mechanical and electrical systems in sensing, communicating and displaying information is covered as well as transmitter and receiver fundamentals and avionics installations and testing.

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b. Credits: Students receive 4 credits for successful completion of this course.

c. Hours: The class is scheduled to meet 5 hours per week for fifteen weeks each semester (4500 min.) in class. In addition (6600 min.) outside work is expected for total student involvement of (11,100 min.)

d. The 74 hours of instruction accounts for two holidays and is devoted entirely to formal classroom presentation.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab Fees: No lab fees.

g. This course in conjunction with the AMT curriculum prepares an individual for entry level positions in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations precede the preplanned, structured lab exercises of the accompanying laboratory course and together they allow the students to become familiar with the aircraft systems and components presented, and to observe and practice the tasks necessary to build skill and confidence in installing, operating and flightline servicing of avionics and instrument systems.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of math, physics, aviation publications, aircraft hardware and aircraft electrical components, before entering this course. This working knowledge may be demonstrated in the following ways:

a. Passing the following courses or their equivalent with a grade of "C" or better:

A T	163	Aircraft Electrical Components
A T	163L	Aircraft Electrical Components Lab
PHYS	110	Physics for Technicians

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IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for make-up are outlined in Appendix B.
b. Class performance is evaluated by written and oral quizzes or tests, class participation and written reports.

V. OUTLINE

1.0 INSTRUMENT BASICS.
  - 1.1 Types of systems: mechanical, electro mechanical, hydro-mechanical, electronic
  - 1.2 System components: sensor, communication, display
  - 1.3 System considerations: accuracy, repeatability, response to airborne environment (vibration, heat, voltage fluctuations), calibration, maintenance, fault annunciation (self test), display quality, readability, (size, color, stability etc.), power requirements

2.0 SENSOR TYPES: SENSE HEAT, PRESSURE, POSITION, FLOW.
  - 2.1 Mechanical sensors: flaps, airflow, angle of attack (AOA), gravity, (slip/skid), mechanical followers (actuator handles, cables/pulley, cam follower), gyros
  - 2.2 Hydro-mechanical sensors: pressure bulb (temperature) diaphragm, aneroid, manometer. (pressure)
  - 2.3 D.C. electro-mechanical (electrical response to mechanical input): potentiometer, carbon pile, tach generator, strain gauge, accelerometer, Hall effect
  - 2.4 D.C. electro thermal: thermistor, bimetalic switch, thermocouple
  - 2.5 A.C. electro-mechanical: E-coil, synchro, resolver, linear variable differential transformer (LVDT), piezoelectric crystal, laser, doppler (flow), capacitance fluid quantity
  - 2.6 A.C. electro-thermal: crystal
  - 2.7 Digital sensors
  - 2.8 Photo-optical: photo-cell, photo-transistor

3.0 DATA COMMUNICATIONS
  - 3.1 Mechanical: pulley and cable, gears, cam follower
  - 3.2 Hydro-mechanical: instrument tubing
  - 3.3 D.C. electric: 1 or 2 wire
  - 3.4 A.C. electric: 1,2,3,4 wire
  - 3.5 Multiplexing
  - 3.6 Digital bus: one direction, 2 direction, 2 wire, 3 wire, 4 wire
  - 3.7 Accuracy
  - 3.8 Faults, integrity checks and failure effects

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A T 264 AIRCRAFT ELECTRICAL SYSTEMS

4.0 COMPUTATION OPERATIONS ON RAW DATA
- 4.1 Mechanical - gears, bellcranks, levers, cams
- 4.2 Hydro-mechanical - diaphragms, springs, pressure leaks
- 4.3 D.C. electric-resistor networks, pots, amplifiers
- 4.4 A.C. electric - pot, amp, VCO, C.T.
- 4.5 Digital - MP, storage, arithmetic

5.0 INFORMATION USERS
- 5.1 Displays
    - a. Mechanical
    - b. Hydro-mechanical
    - c. Electrical AC scope, CRT, synchro
    - d. Electrical DC LCD, LED, meter movement
    - e. Digital CRT, LCD, CED
- 5.2 Controls - command - response
    - a. Mechanical and electro-mechanical
    - b. Electro-hydraulic
    - c. Digital
    - d. Servo system basics
- 5.3 Caution and warning systems
    - a. Mechanical
    - b. Electric/electro-mechanical
    - c. Digital

6.0 COMPLETE INFORMATION (INSTRUMENT) SYSTEMS
- 6.1 Mechanical: e.g. Angle of Attack, slip-skid, flap position (cessna 150), trim position (cub), float gauge gyro instruments (D.G. artificial Horizon)
- 6.2 Hydro-mechanical: e.g. engine oil pressure, oil temperature altimeter, airspeed, VSI
- 6.3 D.C. electric: potentiometer/voltmeter, thermocouple, D.C. servo. e.g. float/POT fuel quantity, flap position (cessna 172), EGT
- 6.4 A.C. electric: LVDT, synchro, tach generator, wheelspeed transducer, AC servo
- 6.5 Digital: TAT/EPRL (total air temperature, engine pressure ratio limit), air data computer, electronic engine control

7.0 TRANSMITTERS AND RECEIVERS
- 7.1 Fundamentals:
    - a. Intercom: transducer-amplifier - communication lines - transducer
    - b. Transceiver: transducer, amplifier, coding, transmission, propagation, reception, amplifying, decoding, transducing
- 7.2 Input Transducer: movement/sound to electrical current
- 7.3 Amplifier: going lower power to high power
- 7.4 Coding: AM, FM, pulse

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- 7.5 Transmission: RF amp, antennas, speed, wavelength, frequency, impedance matching
- 7.6 Propagation: electro-magnetic wave, ground wave, reflected waves, frequency characteristics, FCC allotted frequencies, information content, sidebands, spectrum
- 7.7 Reception: magnetic coupling, electric coupling, receive antenna
- 7.8 Decoding: tuners, sensitivity, selectivity, filters, mixing, oscillators
- 7.9 Output transducer: signal to sound, signal to distance, signal to bearing

8.0 COMMUNICATION SYSTEMS
- 8.1 Intercom, flight interphone, service interphone, passenger address
- 8.2 VHF commmunications
- 8.3 HF communications
- 8.4 ACARS
- 8.5 Audio integrating

9.0 NAVIGATION SYSTEMS: BASIC OPERATION AND USE
- 9.1 Pitot static
- 9.2 Magnetic compass
- 9.3 ADF
- 9.4 VOR
- 9.5 DME
- 9.6 ATC
- 9.7 ILS, LOC and GS
- 9.8 LRRA, (low range radio altimeter).
- 9.9 Attitude information
- 9.10 IRS, (inertial reference system).
- 9.11 Flight director
- 9.12 Performance data/flight management
- 9.13 Autopilot
- 9.14 VLF, LORAN, OMEGA
- 9.15 Marker beacon

10.0 INTEGRATED AVIONICS SYSTEMS
- 10.1 Flight management
- 10.2 EICAS
- 10.3 Performance data computer
- 10.4 Flight and maintenance data recording

11.0 BUILT IN TEST
- 11.1 VOR test
- 11.2 Self checks
- 11.3 Condition annunciators (flags)
- 11.4 BITE routines
  1. meter and sequence
  2. auto with go/no go
  3. auto with readouts

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12.0 AVIONICS INSTALLATIONS
  12.1 Panel mounted instruments
  12.2 Panel mounted radios
  12.3 Remote boxes
  12.4 Connectors: cylindical, flat, Arinc 404, Arinc 600, rack connectors.
  12.5 Wiring: single, twisted, shielding, coax.
  12.6 Equipment cooling: convection, suction, fans, forced air, air-conditioning.
  12.7 Antennas: structural, interference, spacing, orientation, bonding, connections.

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

0.0 REVIEW

Instructional Goal Refamiliarize students with electrical fundamentals, components and data that will be utilized in the course.

Defined Outcome: Students will describe and recognize components, processes and data used in aircraft electronic systems.

1.0 INSTRUMENT BASICS

Instructional Goal: Understand the reasons for and the methods of achieving remote sensing of information and displaying that information.

Defined Outcomes: Students will identify instrument system components on a block diagram level and identify those components that sense the environment, convert information, communicate information and display information and analyze the important factors of complete instrument systems. i.e. accuracy, readability power requirements etc..

2.0 SENSOR TYPES

Instructional Goal: Understand the types of sensors available, what they are used to sense and what other system components they must be matched with.

Defined Outcomes: The student will identify sensors of different types, analyze their operation and combine sensors with other components to create working instrument systems.

A T 264 AIRCRAFT ELECTRICAL SYSTEMS

3.0 DATA COMMUNICATIONS

Instructional Goal: Understand the various methods of communicating information from one location to another and the advantages and disadvantages of each.

Defined Outcomes: The student will analyze different data communication concepts, discuss their limitations and their appropriateness for airborne applications.

4.0 COMPUTATION OPERATIONS

Instructional Goal: Understand how mechanical and electronic devices can be incorporated to perform computations on data used in instrument systems.

Defined Outcomes: The student will choose the proper computational method to be used on a given type of data in a defined instrument system.

5.0 INFORMATION USERS

Instructional Goal: Understand how displays, control systems and warning systems use remotely obtained information.

Defined Outcomes: The student will identify what information must be provided to allow the above systems to properly perform their function and will give a general description of how that information is processed in each system.

6.0 COMPLETE INFORMATION SYSTEMS

Instructional Goal: To understand the proper operation, failure modes, necessary maintenance and testing methods of typical complete airborne instrument systems.

Defined Outcomes: Given example airborne instrument systems the student will analyze the function of each component of that system and research and outline from the manufacturers' information, the above factors for those systems.

7.0 TRANSMITTERS AND RECEIVERS

Instructional Goal: Understand the basic operation and necessary components of AM and FM Transceivers and the natural phenomena that allow their use.

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Defined Outcomes: Students will reproduce block diagrams of AM and FM pulse transceivers and identify the operation of their major components, and define signal condition at identifiable points in the transmit or receive process.

8.0 COMMUNICATION SYSTEMS

Instructional Goals: To understand the use of various types of airborne communication techniques.

Defined Outcomes: Students will identify which type of airborne communication system would best meet a given set of requirements.

9.0 NAVIGATION SYSTEMS

Instructional Goal: To understand the use of various types of airborne navigation systems.

Defined Outcomes: Students will identify which type of airborne navigation system would best meet a given set of requirements. Students will describe the operation and display available from various airborne navigation systems.

10.0 INTEGRATED AVIONICS

Instructional Goal: To create an awareness of the degree of integration of navigation, communication and instrument systems in aircraft.

Defined Outcomes: Students will identify those systems on given aircraft that integrate information from several sources and explain the means of integration and the advantages of integration.

11.0 BUILT IN TEST

Instructional Goal: To identify the advantages and limitations of on-board test equipment for avionics equipment and give some examples of BITE operation.

Defined Outcomes: The students will identify those systems that are equipped with BITE and explain the operation of that equipment.

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A T 264L AIRCRAFT ELECTRICAL SYSTEMS LABORATORY

FAR 147 Item	Level	
	Appendix B (General)	
5	3	Read and interpret electrical circuit diagrams.
	Appendix C (Airframe)	
36	1	Inspect, check, service, troubleshoot and repair heading, speed, altitude, time, attitude, temperature, pressure and position indicating systems.
37	2	Install instruments.
38	1	Inspect, check, and service auto-pilot and approach control systems.
39	1	Inspect, check, and service aircraft electronic communication and navigation systems.
40	2	Inspect and repair antenna and electronic equipment installations.
45	2	Inspect, Repair Fluid Quantity Indicator Systems.
46	2	Troubleshoot, service, and repair fluid pressure and temperature warning systems.
48	2	Repair aircraft electrical system components.
49	3	Install, check, and service airframe, electrical wiring, controls, switches, indicators, and protective devices.
	Appendix D (Powerplant)	
9	2	Troubleshoot, service, and repair fluid rate-of-flow indicating systems.
10	3	Inspect, check, service, troubleshoot, and repair engine temperature, pressure, and r.p.m. indicating systems.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: This course builds on previous course coverage of AC and DC electrical power generation, control and distribution in an airborne environment. Uses of mechanical and electrical systems in sensing, communicating and displaying information is covered as well as transmitter and receiver fundamentals and avionics installations and testing.

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b. Credits: Students receive 1 credit for successful completion of this course.

c. Hours: The class is scheduled to meet 3 hours per week for fifteen weeks each semester (2700 min.) in class. In addition (900 min.) outside work is expected for total student involvement of (3600 min.).

d. The 42 hours of instruction accounts for two holidays and is devoted entirely to laboratory exercises and shop projects.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab Fees: Lab fees for this course are outlined in Appendix A.

g. This course in conjunction with the AMT curriculum prepares an individual for entry level positions in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations precede the preplanned, structured lab exercises of the accompanying lecture course and together they allow the students to become familiar with the aircraft systems and components presented, and to observe and practice the tasks necessary to build skill and confidence in installing, operating and flightline servicing of avionics and instrument systems.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of math, physics, aviation publications, aircraft hardware and aircraft elelctrical, components before entering this course. This working knowledge may be demonstrated in the following ways:

a. Passing the following courses or their equivalent with a grade of "C" or better:

A T	163	Aircraft Electrical Components
A T	163L	Aircraft Electrical Components Lab
PHYS	110	Physics for Technicians

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b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

c. This course must be taken concurrently with AT 264.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for make-up are outlined in Appendix B.

b. Class performance is evaluated by written and oral quizzes or tests, class participation and written reports.

c. Final grades for students are computed by averaging marks for participation and technique on assigned projects. This includes research of documentation, project planning, use of tools, safety, efficiency, thoroughness and records of project results.

V. OUTLINE

1.0 INSTRUMENT BASICS.
- 1.1 Types of systems: mechanical, electro mechanical, hydro-mechanical, electronic
- 1.2 System components: sensor, communication, display
- 1.3 System considerations: accuracy, repeatability, response to airborne environment (vibration, heat, voltage fluctuations), calibration, maintenance, fault annunciation (self test), display quality, readability, (size, color, stability etc.), power requirements

2.0 SENSOR TYPES: SENSE HEAT, PRESSURE, POSITION, FLOW.
- 2.1 Mechanical sensors: flaps, airflow, angle of attack (AOA), gravity, (slip/skid), mechanical followers (actuator handles, cables/pulley, cam follower), gyros
- 2.2 Hydro-mechanical sensors: pressure bulb (temperature) diaphragm, aneroid, manometer. (pressure)
- 2.3 D.C. electro-mechanical (electrical response to mechanical input): potentiometer, carbon pile, tach generator, strain gauge, accelerometer, Hall effect
- 2.4 D.C. electro thermal: thermistor, bimetalic switch, thermocouple
- 2.5 A.C. electro-mechanical: E-coil, synchro, resolver, linear variable differential transformer (LVDT), piezoelectric crystal, laser, doppler (flow), capacitance fluid quantity
- 2.6 A.C. electro-thermal: crystal
- 2.7 Digital sensors
- 2.8 Photo-optical: photo-cell, photo-transistor

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T 264L AIRCRAFT ELECTRICAL SYSTEMS LABORATORY

3.0 DATA COMMUNICATIONS
- 3.1 Mechanical: pulley and cable, gears, cam follower
- 3.2 Hydro-mechanical: instrument tubing
- 3.3 D.C. electric: 1 or 2 wire
- 3.4 A.C. electric: 1,2,3,4 wire
- 3.5 Multiplexing
- 3.6 Digital bus: one direction, 2 direction, 2 wire, 3 wire, 4 wire
- 3.7 Accuracy
- 3.8 Faults, integrity checks and failure effects

4.0 COMPUTATION OPERATIONS ON RAW DATA
- 4.1 Mechanical - gears, bellcranks, levers, cams
- 4.2 Hydro-mechanical - diaphragms, springs, pressure leaks
- 4.3 D.C. electric-resistor networks, pots, amplifiers
- 4.4 A.C. electric - pot, amp, VCO, C.T.
- 4.5 Digital - MP, storage, arithmetic

5.0 INFORMATION USERS
- 5.1 Displays
  - a. Mechanical
  - b. Hydro-mechanical
  - c. Electrical AC scope, CRT, synchro
  - d. Electrical DC LCD, LED, meter movement
  - e. Digital CRT, LCD, CED
- 5.2 Controls - command - response
  - a. Mechanical and electro-mechanical
  - b. Electro-hydraulic
  - c. Digital
  - d. Servo system basics
- 5.3 Caution and warning systems
  - a. Mechanical
  - b. Electric/electro-mechanical
  - c. Digital

6.0 COMPLETE INFORMATION (INSTRUMENT) SYSTEMS
- 6.1 Mechanical: e.g. Angle of Attack, slip-skid, flap position (cessna 150), trim position (cub), float gauge gyro instruments (D.G. artificial Horizon)
- 6.2 Hydro-mechanical: e.g. engine oil pressure, oil temperature altimeter, airspeed, VSI
- 6.3 D.C. electric: potentiometer/voltmeter, thermocouple, D.C. servo. e.g. float/POT fuel quantity, flap position (cessna 172), EGT
- 6.4 A.C. electric: LVDT, synchro, tach generator, wheelspeed transducer, AC servo
- 6.5 Digital: TAT/EPRL (total air temperature, engine pressure ratio limit), air data computer, electronic engine control

A T 264L AIRCRAFT ELECTRICAL SYSTEMS LABORATORY

7.0 TRANSMITTERS AND RECEIVERS

- 7.1 Fundamentals:
  - a. Intercom: transducer-amplifier - communication lines - transducer
  - b. Transceiver: transducer, amplifier, coding, transmission, propagation, reception, amplifying, decoding, transducing
- 7.2 Input Transducer: movement/sound to electrical current
- 7.3 Amplifier: going lower power to high power
- 7.4 Coding: AM, FM, pulse
- 7.5 Transmission: RF amp, antennas, speed, wavelength, frequency, impedance matching
- 7.6 Propagation: electro-magnetic wave, ground wave, reflected waves, frequency characteristics, FCC allotted frequencies, information content, sidebands, spectrum
- 7.7 Reception: magnetic coupling, electric coupling, receive antenna
- 7.8 Decoding: tuners, sensitivity, selectivity, filters, mixing, oscillators
- 7.9 Output transducer: signal to sound, signal to distance, signal to bearing

8.0 COMMUNICATION SYSTEMS

- 8.1 Intercom, flight interphone, service interphone, passenger address
- 8.2 VHF commmunications
- 8.3 HF communications
- 8.4 ACARS
- 8.5 Audio integrating

9.0 NAVIGATION SYSTEMS: BASIC OPERATION AND USE

- 9.1 Pitot static
- 9.2 Magnetic compass
- 9.3 ADF
- 9.4 VOR
- 9.5 DME
- 9.6 ATC
- 9.7 ILS, LOC and GS
- 9.8 LRRA, (low range radio altimeter).
- 9.9 Attitude information
- 9.10 IRS, (inertial reference system).
- 9.11 Flight director
- 9.12 Performance data/flight management
- 9.13 Autopilot
- 9.14 VLF, LORAN, OMEGA
- 9.15 Marker beacon

A T 264L AIRCRAFT ELELCTRICAL SYSTEMS LABORATORY

10.0 INTEGRATED AVIONICS SYSTEMS
- 10.1 Flight management
- 10.2 EICAS
- 10.3 Performance data computer
- 10.4 Flight and maintenance data recording

11.0 BUILT IN TEST
- 11.1 VOR test
- 11.2 Self checks
- 11.3 Condition annunciators (flags)
- 11.4 BITE routines
  1. meter and sequence
  2. auto with go/no go
  3. auto with readouts

12.0 AVIONICS INSTALLATIONS
- 12.1 Panel mounted instruments
- 12.2 Panel mounted radios
- 12.3 Remote boxes
- 12.4 Connectors: cylindical, flat, Arinc 404, Arinc 600, rack connectors.
- 12.5 Wiring: single, twisted, shielding, coax.
- 12.6 Equipment cooling: convection, suction, fans, forced air, air-conditioning.
- 12.7 Antennas: structural, interference, spacing, orientation, bonding, connections.

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

0.0 REVIEW

Instructional Goal: Refamiliarize students with electrical fundamentals, components and data that will be utilized in the course.

Defined Outcome: Students will describe and recognize components, processes and data used in aircraft electronic systems.

1.0 INSTRUMENT BASICS

Instructional Goal: Understand the reasons for and the methods of achieving remote sensing of information and displaying that information.

Defined Outcomes: Students will identify instrument system components on a block diagram level and identify those components that sense the environment, convert information, communicate information and display information and analyze the important factors of complete instrument systems. i.e. accuracy, readability power requirements etc..

A T 264L AIRCRAFT ELECTRICAL SYSTEMS LABORATORY

2.0 SENSOR TYPES

Instructional Goal: Understand the types of sensors available, what they are used to sense and what other system components they must be matched with.

Defined Outcomes: The student will identify sensors of different types, analyze their operation and combine sensors with other components to create working instrument systems.

3.0 DATA COMMUNICATIONS

Instructional Goal: Understand the various methods of communicating information from one location to another and the advantages and disadvantages of each.

Defined Outcomes: The student will analyze different data communication concepts, discuss their limitations and their appropriateness for airborne applications.

4.0 COMPUTATION OPERATIONS

Instructional Goal: Understand how mechanical and electronic devices can be incorporated to perform computations on data used in instrument systems.

Defined Outcomes: The student will choose the proper computational method to be used on a given type of data in a defined instrument system.

5.0 INFORMATION USERS

Instructional Goal: Understand how displays, control systems and warning systems use remotely obtained information.

Defined Outcomes: The student will identify what information must be provided to allow the above systems to properly perform their function and will give a general description of how that information is processed in each system.

6.0 COMPLETE INFORMATION SYSTEMS

Instructional Goal: To understand the proper operation, failure modes, necessary maintenance and testing methods of typical complete airborne instrument systems.

Defined Outcomes: Given example airborne instrument systems the student will analyze the function of each component of that system and research and outline from the manufacturers' information, the above factors for those systems.

7.0 TRANSMITTERS AND RECEIVERS

Instructional Goal: Understand the basic operation and necessary components of AM and FM Transceivers and the natural phenomena that allow their use.

Defined Outcomes: Students will reproduce block diagrams of AM and FM pulse transceivers and identify the operation of their major components, and define signal condition at identifiable points in the transmit or receive process.

8.0 COMMUNICATION SYSTEMS

Instructional Goals: To understand the use of various types of airborne communication techniques.

Defined Outcomes: Students will identify which type of airborne communication system would best meet a given set of requirements.

9.0 NAVIGATION SYSTEMS

Instructional Goal: To understand the use of various types of airborne navigation systems.

Defined Outcomes: Students will identify which type of airborne navigation system would best meet a given set of requirements. Students will describe the operation and display available from various airborne navigation systems.

10.0 INTEGRATED AVIONICS

Instructional Goal: To create an awareness of the degree of integration of navigation, communication and instrument systems in aircraft.

Defined Outcomes: Students will identify those systems on given aircraft that integrate information from several sources and explain the means of integration and the advantages of integration.

11.0 BUILT IN TEST

Instructional Goal: To identify the advantages and limitations of on-board test equipment for avionics equipment and give some examples of BITE operation.

A T 264L AIRCRAFT ELECTRICAL SYSTEMS LABORATORY

Defined Outcomes: The students will identify those systems that are equipped with BITE and explain the operation of that equipment.

12.0 AVIONICS INSTALLATIONS

Instructional Goal: To understand and become skilled at the proper procedures for installation of navigation, communication and instrument systems including box and instrument mounting, wiring, fluid connections, antenna installations, cooling equipment.

Defined Outcomes: Students will demonstrate installation of navigation, communication and instrument systems including box and instrument mounting and wiring, fluid connections, antenna installations, coax installations, shock mounting and electrical bonding.

VII. OUTLINE PROJECTS

FAA Level

2 0.0 Review of ATA 100, wiring diagrams, solid state components, logic and microprocessors.

1 1.0 INSTRUMENT BASICS: Projects as available and appropriate.

2.0 SENSORS
- 2.1 Test accuracy of hydro-mechanical temperature sensor e.g. oil temperature system for light aircraft. 2
- 2.2 Test accuracy of tach generator.
- 2.3 Test accuracy of thermocouple system
- 2.4 Show voltage, phase relationships for synchro or E.coil sensors at various positions.

3.0 DATA COMMUNICATIONS:
- 3 3.1 Check and rig mechanical position indicator.
- 3.2 Check integrity and operations of pitot-static tubing.
- 3.3 Check integrity of AC and DC electric indicator wiring.
- 2 3.4 Check waveform and information content of digital pulse train, e.g. Arinc 429, Mil-Std-1553, ASCB.
- 3.6 Observe and measure effects of EMI on various instrument communication systems.

4.0 COMPUTATION OPERATIONS: Projects as available and appropriate. 1

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... Level

5.0 INFORMATION USERS

3 5.1 Identify components and operation of mechanisms in instrument displays.

5.2 Observe and assure proper operation of servo systems.

5.3 Observe and interpret displays of caution and warning annunciators.

6.0 COMPLETE INFORMATION SYSTEMS

3

6.1 Check operation and accuracy of mechanical instrument system.

6.2 Check operation and accuracy of hydro-mechanical instrument system. Perform pitot-static check on aircraft in accordance with FAR parts 91, 43 and manufacturer's maintenance manual.

6.3 Determine accuracy and resolution of synchro instrument system.

6.4 Test and service complete vacuum driven gyro system.

7.0 TRANSMITTERS AND RECEIVERS

2 7.1 a. Observe signal frequencies and amplitude at various points in an intercom system.

7.1 b. Observe signals frequencies and amplitudes at various points in a com transceiver.

7.2 Use ramp test equipment to determine transmitted power and VSWR for various installations.

7.3 Perform ramp test on VOR system using local VOT facility.

7.4 Perform ramp test on VOR, LOC, GS and MKR BCN system using portable ramp test equipment.

8.0 COMMUNICATIONS

8.1 Install and operate a portable intercom system.

3

9.0 NAVIGATION SYSTEMS

1 9.1 Use ramp test equipment and local test transmitters to check accuracy of navigational radios installed in aircraft.

9.2 Check operation of autopilot and flight director installed on various aircraft in accordance with manufacturers' instructions.

9.3 Observe self checks, engagement and disengagement of autopilot system.

1 10.0 INTEGRATED AVIONICS: Projects as available or applicable.

1 11.0 BUILT IN TEST EQUIPMENT

11.1 Perform LOC, GS, MKR BCN, flight director or autopilot tests using built in test equipment.

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A T 264L AIRCRAFT ELECTRICAL SYSTEMS LABORATORY

FAA Level

12.0 AVIONICS INSTALLATIONS

12.1 Install panel mounted instruments (round and square).
3 12.2 Install panel mounted radios.
12.3 Install remote avionics components.
12.4 Wire and install in-line, rack, and panel connectors.
12.5 Install and terminate aircraft wires of the following types: single, twisted pairs, shielded wires, coax.
12.6 Install an aircraft antenna.

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A T 265 AIRCRAFT BONDED STRUCTURES
60 HOURS

at265.kw

FAR 147 APPENDIX C (Airframe)

Item	Level	
1	1	Service and repair wood structures.
2	2	Identify wood defects.
3	2	Inspect wood structures.
11	2	Inspect bonded structures.
12	2	Inspect and repair plastics, honeycombs, and laminated structures.
13	2	Inspect, check, service and repair windows, doors, and interior furnishings.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Beginning with historical background, the student will be taught the theory of and techniques used in the fabrication, inspection and repair of bonded structures. Areas covered include plastics, wood structures, honeycomb structures, and advanced composite structures.

b. Credits: Students will receive 3 credits for successful completion of the course.

c. Hours: The course is scheduled to meet 4 hours per week for fifteen weeks each semester (3600 min.) in class. In addition (4500 min.) of outside work is expected for total student involvement of (8100 min.).

d. The 60 hours of instruction accounts for two holidays and is devoted entirely to formal classroom presentations.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab fees: No lab fees.

g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions in the aviation maintenance field.

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A T 265 AIRCRAFT BONDED STRUCTURES

II. ACTIVITIES

Formal lecture and demonstrations will precede preplanned, structured lab exercises that are presented in the accompanying laboratory course and allow the students to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance functions on bonded structures. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

a. Must be taken concurrently with AT 265L, Bonded Structures Laboratory.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for make-up are outlined in Appendix B.

b. Class performance will be evaluated by written or oral examinations.

V. OUTLINE

1.0 Introduction
    1.1 Plastic and composite development history.
    1.2 Current plastic and composite applications.
    1.3 Plastic and composite terminology.

2.0 Wood Structures as Composites
    2.1 Service and repair of wood structures.
    2.2 Identify wood defects.
    2.3 Inspection of wood structures.

3.0 Plastic Enclosures
    3.1 Inspection and repair of plastic enclosures.
        a. Windows
        b. Doors
        c. Furnishings

4.0 Characteristics of Advanced Composites
    4.1 Properties of materials
        a. Resin matrix
        b. Reinforcing materials
        c. Fasteners
        d. Core materials e.g. honey comb, solid

- 4.2 Assembly
    - a. Cleanliness e.g. inclusions, contaminants
    - b. Ply orientation
    - c. Resin systems
    - d. Bagging and heat
    - e. Cure time
- 4.3 Bonding techniques
    - a. Wet lay-up
    - b. Bagging
    - c. Two part mold
    - d. Porosity
- 4.4 Specifications
    - a. Process specs
    - b. Material specs
    - c. Piece specs
- 4.5 Material controls
    - a. Refrigeration
    - b. Humidity
- 4.6 Loads
    - a. Primary
    - b. Secondary
- 4.7 Design guides
    - a. Safety factors
    - b. Material selection
    - c. Process selection

5.0 Composite Processes

- 5.1 Inspection of assemblies
    - a. Dimensional
    - b. Bond
    - c. Cure
- 5.2 Bond line defects
    - a. Resisn content
    - b. Foreign matter
    - c. Film thickness
- 5.3 NDI techniques
    - a. Ultra-sonic material defects
    - b. "Coin tap"
    - c. X-ray
- 5.4 Material defects
    - a. Debonding
    - b. Improper cure
    - c. Improper storage
- 5.5 Effects of chemicals
    - a. Chemical cleaner
    - b. Painting systems
    - c. Fuels
- 5.6 Environmental agents
    - a. Ultraviolet light
    - b. Infrared light
    - c. Surface heating
    - d. Age

- 5.7 Damage tolerances
    - a. Impact
    - b. Overloading
    - c. Abrasion
    - d. Notching
- 5.8 Lightning strike
    - a. Heat damage
    - b. Conductivity
    - c. Inlaid conductors

6.0 Field Inspection and Repair

- 6.1 Facilities and equipment and data
    - a. Hot bond equipment
    - b. Ultra-sonic
    - c. Vacuum equipment
- 6.2 Inspection criteria
    - a. Bond failures
    - b. Fabric failures
    - c. Matrix failures
- 6.3 Materials and alternatives
- 6.4 Field repairs
    - a. Wet lay- up
    - b. Vacuum bagging

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 INTRODUCTION

Instructional Goal: Know the history, contemporary applications and terminology associated with plastics and composites.

Defined Outcomes: The student will describe the history of plastics and composites. He will enumerate contemporary applications and will use plastic and composite terminology.

2.0 WOOD STRUCTURE AS COMPOSITES

Instructional Goal: Know the service and inspection procedures for wood structures.

Defined Outcomes: The student will inspect and correctly identify defects in wood structures.

3.0 PLASTIC ENCLOSURES

Instructional Goal: Know the inspection and repair procedures for plastic enclosures.

Defined Outcomes: The student will describe the repair procedures for windows, doors and furnishings.

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A T 265 AIRCRAFT BONDED STRUCTURES

4.0 CHARACTERISTICS OF ADVANCED COMPOSITES

Instructional Goal: Know the effects of outside forces as composite structures and the design features for coping with them.

Defined Outcomes: The students will describe how outside forces affect composite structures and design features for coping with them.

5.0 COMPOSITE PROCESSES

Instructional Goal: Know the process for assembling and testing composite parts and pieces.

Defined Outcomes: The student will describe the process for assembling and testing composite parts and pieces.

6.0 FIELD INSPECTION AND REPAIR

Instructional Goal: Know the process for field inspection and repair of composite structures.

Defined Outcomes: The student will describe the process for field inspection and repair of composite structures.

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A T 265L AIRCRAFT BONDED STRUCTURES LABORATORY

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FAR 147 APPENDIX C (Airframe)

Item	Level	
1	1	Service and repair wood structures.
2	2	Identify wood defects.
3	2	Inspect wood structures.
11	2	Inspect bonded structures.
12	2	Inspect and repair plastics, honeycombs, and laminated structures.
13	2	Inspect, check, service and repair windows, doors, and interior furnishings.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Beginning with historical background, the student will develop skills in the techniques used for fabrication, inspection and repair of bonded structures. Areas covered include plastics, wood structures, honeycomb structures and advanced composite structures.

b. Credits: Students will receive 2 credits for successful completion of the course.

c. Hours: The course is scheduled to meet 4 hours per week for fifteen weeks each semester (3600 min.) in class. In addition (1800 min.) outside work is expected for total student involvement of (5400 min.).

d. The 56 hours of instruction accounts for two holidays and is devoted entirely to laboratory exercises.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab fees: Fees for this course are outlined in appendix "A".

g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions in the aviation maintenance field.

AT 265L AIRCRAFT BONDED STRUCTURES LABORATORY

II. ACTIVITIES

Formal lecture and demonstrations in the accompanying lecture course precedes preplanned, structured lab exercises that allow the students to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance functions on bonded structures. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

a. Must be taken concurrently with AT 265, Bonded Structures Lecture.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for makeup are outlined in Appendix B.

b. Class performance will be evaluated by written or oral examinations.

V. OUTLINE

1.0 Introduction
  1.1 Plastic and composite development history.
  1.2 Current plastic and composite applications.
  1.3 Plastic and composite terminology.

2.0 Wood Structures as Composites
  2.1 Service and repair of wood structures.
  2.2 Identify wood defects.
  2.3 Inspection of wood structures.

3.0 Plastic Enclosures
  3.1 Inspection and repair of plastic enclosures.
    a. Windows
    b. Doors
    c. Furnishings

4.0 Characteristics of Advanced Composites
  4.1 Properties of materials
    a. Resin matrix
    b. Reinforcing materials
    c. Fasteners
    d. Core materials e.g. honey comb, solid

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- 4.2 Assembly
  - a. Cleanliness e.g. inclusions, contaminants
  - b. Ply orientation
  - c. Resin systems
  - d. Bagging and heat
  - e. Cure time
- 4.3 Bonding techniques
  - a. Wet lay-up
  - b. Bagging
  - c. Two part mold
  - d. Porosity
- 4.4 Specifications
  - a. Process specs
  - b. Material specs
  - c. Piece specs
- 4.5 Material controls
  - a. Refrigeration
  - b. Humidity
- 4.6 Loads
  - a. Primary
  - b. Secondary
- 4.7 Design guides
  - a. Safety factors
  - b. Material selection
  - c. Process selection

5.0 Composite Processes

- 5.1 Inspection of assemblies
  - a. Dimensional
  - b. Bond
  - c. Cure
- 5.2 Bond line defects
  - a. Resisn content
  - b. Foreign matter
  - c. Film thickness
- 5.3 NDI techniques
  - a. Ultra-sonic Material defects
  - b. "Voin tap"
  - c. X-ray
- 5.4 Material defects
  - a. Debonding
  - b. Improper cure
  - c. Improper storage
- 5.5 Effects of chemicals
  - a. Chemical cleaner
  - b. Painting systems
  - c. Fuels
- 5.6 Environmental agents
  - a. Ultraviolet light
  - b. Infrared light
  - c. Durface heating
  - d. Age

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- 5.7 Damage tolerances
  - a. Impact
  - b. Overloading
  - c. Abrasion
  - d. Notching
- 5.8 Lightning strike
  - a. Heat damage
  - b. Conductivity
  - c. Inlaid conductors

6.0 Field Inspection and Repair

- 6.1 Facilities and equipment and data
  - a. Hot bond equipment
  - b. Ultra-sonic
  - c. Vacuum equipment
- 6.2 Inspection criteria
  - a. Bond failures
  - b. Fabric failures
  - c. Matrix failures
- 6.3 Materials and alternatives
- 6.4 Field repairs
  - a. Wet lay-up
  - b. Vacuum bagging

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 INTRODUCTION

Instructional Goal Know the history, contemporary applications and terminology associated with plastics and composites.

Defined Outcomes The student will describe the history of plastics and composites. He will enumerate contemporary applications and will use plastic and composite terminology.

2.0 WOOD STRUCTURE AS COMPOSITES

Instructional Goal Service and inspect wood structures.

Defined Outcome The student will inspect and identify defects in wood structures.

3.0 PLASTIC ENCLOSURES

Instructional Goal Inspect and repair plastic enclosures.

Defined Outcomes: The student will repair windows, doors and furnishings.

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A T 265L AIRCRAFT BONDED STRUCTURES LABORATORY

4.0 CHARACTERISTICS OF ADVANCED COMPOSITES

Instructional Goal: Know the effects of outside forces on composite structures and the design features for coping with them.

Defined Outcomes: The students will observe how outside forces affect composite structures and note design features for coping with them.

5.0 COMPOSITE PROCESSES

Instructional Goal: Know the process for assembling and testing composite parts and pieces.

Defined Outcomes: The student will assemble and test composite parts and pieces.

6.0 FIELD INSPECTION AND REPAIR

Instructional Goal: Field inspection and repair of composite structures.

Defined Outcomes: The student will perform field inspection and repair of composite structures.

VII. PROJECTS

FAA Level		
1	1.0	Projects as available and appropriate
2	2.0	Inspect a wood structure for damage and defects. Select suitable wood for use in repairs.
3	3.0	Perform a bonded repair to a clear acrylic enclosure. Clean and remove scratches from acrylic.
1	4.0	Projects as available and appropriate.
2	5.0	Make a mold and mold a composite part using a vacuum bag process.
2	6.0	a. Repair an aluminum faced "Honeycomb" part. b. Repair an epoxy laminate faced cored part. c. Repair a non-cored composite laminate. d. Assist in using a hot bond machine in making a composite repair. e. Make an ultrasonic inspection of representative composite parts.

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FAR 147 APPENDIX C (AIRFRAME)

ITEM	LEVEL	
33	1	Repair heating, cooling, air-conditioning, pressurization and oxygen system components.
34	1	Inspect, check, troubleshoot, service and repair heating, airconditioning, cooling and pressurization systems.
35	2	Inspect, check, troubleshoot, service and repair oxygen systems.
49	3	Install, service check airframe electrical wiring, switches, controls, indicators and protective devices.
51	1	Inspect, check and service, speed and takeoff warning systems, electrical brake controls and anti-skid systems.
52	3	Inspect, check, troubleshoot, service, and repair landing gear position indicating and warning systems.
53	2	Inspect, check, troubleshoot, service and repair airframe ice and rain control systems.
54	1	Inspect, check, and service smoke and carbon monoxide detection systems.
55	3	Inspect, check, service, troubleshoot and repair aircraft fire detection and extinguishing systems.

APPENDIX D (POWERPLANT)

11	3	Inspect, check, service, troubleshoot and repair engine fire detection and extinguishing systems.
33	1	Inspect, check, service and repair propeller synchronizing and ice control systems.

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A T 266 AIRCRAFT AUXILIARY SYSTEMS

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: This course covers operation, maintenance, servicing, inspection and troubleshooting of auxiliary systems on aircraft. These are systems that are not required to power or control an aircraft in flight but do enhance safety, improve comfort, or extend capabilities of the aircraft. They include environmental control systems (heat, air-conditioning, pressurization, oxygen), ice and rain control systems, fire protection and position indicating and warning systems.

b. Credits: Students receive 3 credits for successful completion of this course.

c. Hours: This course is scheduled to meet 4 hours per week for fifteen weeks for a total of (3600 min.) in class. In addition (4500 min.) outside work is expected for total student involvement of (8100 min.).

d. The 58 hours of instruction accounts for two holidays and is devoted entirely to formal classroom presentations.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab Fees: No lab fees.

g. This course, in conjunction with the AMT curriculum, prepares a student for entry level position in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations in this course precede preplanned, structured lab exercises in the accompanying laboratory course and allow the students to observe and practice the tasks necessary to build skill and confidence in operating and performing the required maintenance functions on auxiliary systems and their components. Emphasis will be placed on electrical control of mechanical systems and troubleshooting techniques for those systems. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of physics, electricity and aircraft maintenance practices before entering this course. This working knowledge may be demonstrated in the following ways:

A T 266 AIRCRAFT AUXILIARY SYSTEMS

a. Passing of the following courses, or their equivalent with a grade of C or better:

A T 160	Aircraft Information, Regulations and Procedures
A T 161	Aircraft Assembly
A T 161L	Aircraft Assembly Lab
A T 264	Aircraft Electrical Systems
A T 264L	Aircraft Electrical Systems Lab

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

c. This course must be taken concurrently with AT 266L Auxiliary Systems Lab.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for make up are listed in Appendix B.

b. Class performance is evaluated by means of written or oral tests and quizzes and class participation.

V. OUTLINE

1.0 Environmental Control Systems - Overview and History of Development
  1.1 Heating: exhaust heat exchangers, combustion heaters, compressors/bleed air.
  1.2 Cooling: vapor cycle airconditioning, air cycle air conditioning.
  1.3 Pressurization: FAR's for pressurization and Oxygen, extended capabilities of pressurized aircraft.
  1.4 Oxygen: gaseous HP and LP (high pressure and low pressure), liquid oxygen, chemical generators

2.0 Cabin Heat - Exhaust Heat Exchangers
  2.1 Exhaust gas flow
  2.2 Heated air flow
  2.3 Heat exchanger (baffles, surface area, temperature differential).
  2.4 Heated air control - cabin/carburetor
  2.5 Factors affecting cabin heat (system design, OAT, power setting, airspeed)
  2.6 Inspecting and servicing cabin heat systems (heat muff inspection, valves and actuating cables, flight deck CO check, cabin heat airworthiness directives).

3.0 Cabin Heat - Combustion Heaters
  3.1 Fuel system: supply, valves, press control, pumps, low press and wick, high press and nozzle, safety valve, drain valve.

- 3.2 Ignition: glow plug, high tension plug and exciter
- 3.3 Combustion Liner: design, materials, integrity checks
- 3.4 Combustion air flow
- 3.5 Ventilating air flow
- 3.6 Operation
- 3.7 Electrical control and schematics
- 3.8 Inspection, servicing, airworthiness directives.

4.0 Vapor Cycle Air-Conditioning
- 4.01 Theory of operation: heat of compression, vaporization, condensation
- 4.1 Compressor: engine driven, electric motor driven, clutch, RPM range power required, pressure at input and output, lubrication.
- 4.2 Condenser: location, airflow, refrigerant flow, pressure
- 4.3 Receiver dryer.
- 4.4 Expansion valve: oriface, thermostatic control, compensation for evaporator size
- 4.5 Evaporator: position, design, internal pressure, airflow
- 4.6 Operation: temperature and pressures in cycle.
- 4.7 Servicing: evacuating, purging, charging, lubrication, leak check.
- 4.8 Repairing: water in lines, slugging compressor, slipping belts, clutches, checking and adding lubricant.

5.0 Air Cycle Air-conditioning
- 5.1 Theory of operation: heat of compression, heat of expansion, heat exchangers, mixing air flows
- 5.2 Air source: bleed air, turbo-compressor, roots blower
- 5.3 Filters and shutoff valves (sov): source, cross bleed
- 5.4 Primary heat exchanger: ambient air flow, cooling air flow, temperature drop.
- 5.5 Compressor: temperature and pressure changes, power required.
- 5.6 Secondary heat exchanger: ambient air flow, cooling airflow, temperature drop.
- 5.7 Turbine: expansion, temperature drop, work extracted.
- 5.8 Mix valve: motor drive, butterflies
- 5.9 Water separator: design, servicing
- 5.10 Temperature controls: cabin sensors, duct sensors, displays, pilot controls
- 5.11 Temp limit sensors: cold limit (e.g. 35 degree F,) Hot limit, (e.g. 190 degree automatic, 240 degree manual).
- 5.12 System operation: automatic, manual
- 5.13 System servicing and troubleshooting

6.0 Pressurization Systems
- 6.1 Theory of operation: pressure vessel, uncontrolled flow in, controlled flow out.
- 6.2 Sources of flow: turbocharger, cabin supercharger, turbocompressor, bleed air
- 6.3 Pressure vessel characteristics: contained volume, minimize leaks, seals for wires, cables, fluid lines, round corners on windows and doors, fatigue checks, pressure limits (e.g. 4.5 to 12 PSID.)
- 6.4 Outflow Valve control: pneumatic valve - reference chamber, differential operation, isobaric operation, electrically operated valve: automatic, manual, standby operations. automatic controls: control of cabin altitude, differential pressure, rate of climb.
- 6.5 Safety Valves: pressure relief valves, dump valves, negative pressure relief valves.
- 6.6 Operation, servicing and troubleshooting

7.0 Oxygen Systems
- 7.1 Oxygen requirements in pressurized and unpressurized aircraft, FAR's 23. 1441, 91.32
- 7.2 Types of Oxygen systems: low press gas, high press gas, liquid oxygen, chemical oxygen generators.
- 7.3 Gaseous oxygen: bottles: HP., LP., DOT 3AA, DOT 3HT, regulators, relief valves, blow-out plugs, distribution lines, control valves, refilling
- 7.4 Liquid oxygen: storage container, evaporator, controls, refilling, distribution
- 7.5 Chemical oxygen generators: chemical reaction, oxygen output, by-products, starting reaction, distribution of oxygen, heat generated, servicing
- 7.6 Operation servicing and troubleshooting of oxygen systems: leak detection, cleaning lines, replacing seals or connections, hydrostatic checking of cylinders.
- 7.7 Portable oxygen systems
- 7.8 Breathing apparatus: oriface with rebreather bag, diluter/demand masks, pressure demand mask and control.

8.0 Fire Protection - Detection
- 8.1 Fire zones: FAR 25.1181 engine, APU, accessory area, cargo, lavatory, wheelwell, combustion heaters, passenger/crew areas
- 8.2 Spot detectors: thermoswitch operation, positioning, wiring, warnings (aural, visual) limitations, maintenance, testing
- 8.3 Thermocouple: thermocouple operation, positioning, wiring absolute temperature vs. rate of rise, limitations, testing, servicing
- 8.4 Continuous loop systems: single wire thermistor, twin wire eutectic salt, gas pressure systems. Construction, connections, installation, testing, servicing, repairing, warnings, operation

8.5 Smoke detectors: photo, optical, ionization. Operation, testing, servicing.

9.0 Fire Protection - Extinguishing
- 9.1 Theory: cool, remove combustible material, remove oxygen interference with combustion process (i.e. halon).
- 9.2 Classes of fire: A,B,C
- 9.3 Types of extinguishers: Liquid (water), dry chem, gas
- 9.4 Portable extinguishers
- 9.5 Built-in extinguishing systems: for engines, APU, wheel well, lavatories; storage of extinguishant, discharge of bottles (valve, squibb), directing of extinguisher, blow-out plugs
- 9.6 Properties and effects of extinguishing agents: water, Dry chemical, carbon dioxide, Halon 1301, Halon 1211.
- 9.7 Operation of extinguishing systems
- 9.8 Servicing of extinguishing systems: weight, pressure, temperature compensation

10.0 Ice and Rain Control
- 10.1 Overview: types of ice and icing conditions: rime, clear, frost. Effects of ice on thrust, lift, drag, weight, control, stability. Ice prone areas: leading edges, masts, antennas, inlets, probes, windshields, props.
- 10.2 Types of ice control: ground removal, anti-cing, deicing. Anti-ice/deice systems: thermal, mechanical, chemical.
- 10.3 Thermal deice systems:
  - a. Electrically heated elements: windshields, props, flight controls.
  - b. Components of electric deice systems.
  - c. Inspection and servicing of electric deice systems.
  - d. Hot air deice system.
- 10.4 Mechanical ice removal
  - a. Components and operation: build up and removal of ice, relies on slip stream; upsets airflow over wing, boot inflation.
  - b. Pneumatic deicer inspection, servicing, repair, removal and installation.
- 10.5 Chemical ice removal:
  - a. Types: ground, airborne: windshield, props, leading edge.
  - b. Props: supply, pump, control valve, slinger ring, boots, operational considerations, maintenance.
  - c. Weeping leading edge: supply, pump, medium used, control operation, care and maintenance of components

10.6 Windshield ice/rain control: windshield wipers, pneumatic air blast, rain repellent.
10.7 Miscellaneous deiced components: electric: drain masts, probes, engine inlets, static ports. Hot air: antennas, engine inlets.
10.8 Inertial separators.

11.0 Position and Warning Systems
11.1 Overview:
- a. Caution: alert of abnormal situation.
- b. Warning: requires immediate attention.
- c. System annunciations: displays condition or mode of operation.

11.2 Types of Warnings:
- a. Visual: lights, flags, CRT displays
- b. Aural: bells, clackers, sirens, horns
- c. Tactile: stick shaker, rudder shaker, stick pusher.

11.3 Conditions requiring warnings: fire, overspeed, stall, improper configuration, ground proximity, autopilot disconnect, low cabin pressure.
11.4 Conditions requiring cautions; abnormal system conditions: low temperature, high temperature, overspeed, underspeed, low pressure, high pressure, low voltage, high voltage.
11.5 Conditions requiring annunciations:
- a. Mode select: on/off, up/down, auto, manual, standby, hi/lo, etc.
- b. Built-in monitoring (status flags): power monitor, signal valid/invalid, display valid/invalid, display comparisons

11.6 Typical display and annunciation systems:
Sensor - communication - decision - display
11.7 Typical annunciation and warning systems: landing gear position, autopilot/flight director mode, configuration warning, takeoff, landing, instrument comparator. system annunciations. Master caution system and caution advisory panels.

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 ENVIRONMENTAL CONTROL

Instructional Goal Know the reasons for development and the history of development of auxiliary systems on aircraft.

Defined Outcome The student will describe the development of auxiliary systems for use on aircraft and explain the additional comfort, safety and capabilities they provide.

A T 266 AIRCRAFT AUXILIARY SYSTEMS

2.0 CABIN HEAT - EXHAUST HEAT EXCHANGERS

Instructional Goal Know the components required and understand the operation and inspection and servicing requirements for exhaust gas heat exchangers.

Defined Outcome The student will describe component and system operation, and explain procedures for moving, inspecting, reinstalling and testing exhaust gas heating systems.

3.0 CABIN HEAT - COMBUSTION HEATER

Instructional Goal Understand system operation, inspection and servicing requirements.

Defined Outcome Students will describe and explain procedures for operating, inspecting and servicing a combustion heater and isolate the causes of system malfunctions given system components, failure reports and documentation.

4.0 VAPOR CYCLE AIR CONDITIONING

Instructional Goal Understand properties and methods of heat transfer. Understand the changes of state occurring in a vapor cycle. Understand system operation, inspection and servicing requirements.

Defined Outcome Students will describe and explain procedures for operating, inspecting and servicing a vapor cycle air conditioning system and isolate the causes of system malfunctions given system components, failure reports and documentation.

5.0 AIRCYCLE AIR-CONDITIONING

Instructional Goal Understand heat transfer properties and temperature and pressure relationships in gases. Understand air cycle system operation, inspection and servicing requirements.

Defined Outcome Students will describe the cooling and heating airflow paths through an air cycle system and define general temperature and pressure conditions at points in the gas path. The students will describe the purpose and operation of flow control values, temperature sensors and control systems used to operate the system. Given documentation and failure symptoms, students will isolate the most probable causes of system failure.

6.0 PRESSURIZATION SYSTEMS

Instructional Goal Understand the reason for pressurization systems on aircraft, their operation and limitations, the components necessary for proper functioning, servicing and inspection requirements and analysis of failures.

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Defined Outcome Students will describe the operation of all components of a pressurization system as well as total system operation. They will recognize components and describe their locations on an aircraft. They will correctly determine the most probable causes of system failure given flight crew write-ups, and system documentation.

7.0 OXYGEN SYSTEMS

Instructional Goal Understand the human requirements for supplemental oxygen at altitude and the effects of a deficiency of oxygen on capabilities. Know the most common methods of providing supplemental oxygen to passengers and flight crews and know the operation, servicing and inspection requirements for those systems.

Defined Outcome The students will describe the requirements for supplemental oxygen from a physiological and regulatory standpoint. They will describe the operation of airborne systems that provide supplemental oxygen, the purpose of each component of those systems and the servicing and inspection requirements of each system. They will analyze irregular operation and determine the most probable causes of system malfunctions.

8.0 FIRE PROTECTION - DETECTION

Instructional Goal Understand the causes of airborne fires and the common means of detecting their occurrence. Know the systems and components required to detect fires and the operation of the warning systems that alert flight crews to the occurance of fires.

Defined Outcome The students will describe causal conditions and locations where fires are likely to occur in aircraft and describe the systems and components that are used to detect their occurrence. Students will explain differences between detection systems along with inspection and servicing requirements for those systems.

9.0 FIRE PROTECTION - EXTINGUISHING

Instructional Goal Know the agents and equipment used to extinguish fires with airborne equipment, their limitations and their design characteristics, inspection and servicing requirements.

Defined Outcome The student will describe the common methods of fire extinguishing, the agent effectiveness and limitations on the different classes of fires. The student will describe the equipment design characteristics, and inspection and servicing requirements.

A T 266 AIRCRAFT AUXILIARY SYSTEMS

10.0 ICE AND RAIN CONTROL

Instructional Goal Know the systems used on aircraft external surfaces to control accumulations of ice or rain that could be detrimental to aircraft operation. Understand system operation, limitations and servicing requirements.

Defined Outcome Students will describe the common methods of ice removal and prevention, the systems and components that accomplish this and the operation, servicing and inspection requirements for those systems.

11.0 POSITION AND WARNING SYSTEMS

Instructional Goal Know those conditions that require cautions, warnings and annunciations to a flight crew and those systems that are used to provide the annunciations or warnings or position indications.

Defined Outcome The student will describe those conditions that require annunciations, warnings or cautions, identify the components of annunciation systems that act as sensors, communicators, decision makers and displays and describe their operation.

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FAR 147 APPENDIX C (AIRFRAME)

ITEM	LEVEL	
33	1	Repair heating, cooling, air- conditioning, pressurization and oxygen system components.
34	1	Inspect, check, troubleshoot, service and repair heating, airconditioning, cooling and pressurization systems.
35	2	Inspect, check, troubleshoot, service and repair oxygen systems.
49	3	Install, service check airframe electrical wiring, switches, controls, indicators and protective devices.
51	1	Inspect, check and service, speed and takeoff warning systems, electrical brake controls and anti-skid systems.
52	3	Inspect, check, troubleshoot, service, and repair landing gear position indicating and warning systems.
53	2	Inspect, check, troubleshoot, service and repair airframe ice and rain control systems.
54	1	Inspect, check, and service smoke and carbon monoxide detection systems.
55	3	Inspect, check, service, troubleshoot and repair aircraft fire detection and extinguishing systems.

APPENDIX D (POWERPLANT)

11	3	Inspect, check, service, troubleshoot and repair engine fire detection and extinguishing systems.
33	1	Inspect, check, service and repair propeller synchronizing and ice control systems.

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A T 266L AIRCRAFT AUXILIARY SYSTEMS LABORATORY

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: This course covers operation, maintenance, servicing, inspection and troubleshooting of auxiliary systems on aircraft. These are systems that are not required to power or control an aircraft in flight but do enhance safety, improve comfort, or extend capabilities of the aircraft. They include environmental control systems (heat, air-conditioning, pressurization, oxygen), ice and rain control systems, fire protection and position indicating and warning systems. Actual aircraft systems or mock-ups are used to provide hands-on training in operation and servicing while troubleshooting exercises are performed either using actual systems or system schematics, wiring diagrams and maintenance information.

b. Credits: Students receive 2 credits for successful completion of this course.

c. Hours: This course is scheduled to meet 4 hours per week for fifteen weeks each semester (3600 min.) in class. In addition (1500 min.) outside work is expected for total student involvement of (5400 min.).

d. The 60 hours of instruction accounts for two holidays and is devoted entirely to laboratory exercises.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab fees: Lab fees for this course are outlined in Appendix A.

g. This course, in conjunction with the AMT curriculum, prepares a student for entry level position in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations in the accompanying lecture class precede preplanned, structured lab exercises that allow students to observe and practice the tasks necessary to build skill and confidence in operation, inspection, servicing and troubleshooting of aircraft auxiliary systems. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

A T 266L AIRCRAFT AUXILIARY SYSTEMS LABORATORY

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of physics, electricity and aircraft maintenance practices before entering this course. This working knowledge may be demonstrated in the following ways:

a. Passing the following courses, or their equivalent with a grade of C or better:

A T 160	Aircraft Information, Regulations and Procedures
A T 161	Aircraft Assembly
A T 161L	Aircraft Assembly Lab
A T 264	Aircraft Electrical Systems
A T 264L	Aircraft Electrical Systems Lab
PHYS 110	Physics for Technicians

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

c. This course must be taken concurrently with AT 266 Auxiliary Systems lecture course.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for make-up are listed in Appendix B.

b. Class performance is evaluated by means of written or oral tests and quizzes and class participation.

V. OUTLINE

1.0 Environmental Control Systems - Overview and History of Development
  1.1 Heating: exhaust heat exchangers, combustion heaters, compressors/bleed air.
  1.2 Cooling: vapor cycle air-conditioning, air cycle air-conditioning.
  1.3 Pressurization: FAR's for pressurization and Oxygen, extended capabilities of pressurized aircraft.
  1.4 Oxygen: gaseous HP and LP (High pressure and low pressure), liquid oxygen, chemical generators

2.0 Cabin Heat - Exhaust Heat Exchangers
  2.1 Exhaust gas flow
  2.2 Heated air flow
  2.3 Heat exchanger (baffles, surface area, temperature differential).
  2.4 Heated air control - cabin/carburetor
  2.5 Factors affecting cabin heat (system design, OAT, power setting, airspeed)

- 2.6 Inspecting and servicing cabin heat systems (heat muff and associated exhaust components inspection, valves and actuating cables, flight dect CO check, cabin heat airworthiness directives).

3.0 Cabin Heat - Combustion Heaters
- 3.1 Fuel system: supply, valves, press control, pumps, low press and wick, high press and nozzle, safety valve, drain valve.
- 3.2 Ignition: glow plug, high tension plug and exciter
- 3.3 Combustion liner: design, materials, integrity checks
- 3.4 Combustion air flow
- 3.5 Ventilating air flow
- 3.6 Operation
- 3.7 Electrical control and schematics
- 3.8 Inspection, servicing, airworthiness directives.

4.0 Vapor Cycle Air-Conditioning
- 4.01 Theory of operation: heat of compression, vaporization, condensation
- 4.1 Compressor: engine driven, electric motor driven, clutch, RPM range power required, pressure at input and output, lubrication.
- 4.2 Condenser: location, airflow, refrigerant flow, pressure
- 4.3 Receiver dryer.
- 4.4 Expansion valve: oriface, thermostatic control, compensation for evaporator size
- 4.5 Evaporator: position, design, internal pressure, airflow
- 4.6 Operation: temperature and pressures in cycle.
- 4.7 Servicing: evacuating, purging, charging, lubrication, leak check.
- 4.8 Repairing: water in lines, slugging compressor, slipping belts, clutches, checking and adding lubricant.

5.0 Air Cycle Air-conditioning
- 5.1 Theory of operation: heat of compression, heat of expansion, heat exchangers, mixing air flows
- 5.2 Air source: bleed air, turbo-compressor, roots blower
- 5.3 Filters and shutoff valves (sov): source, cross bleed
- 5.4 Primary heat exchanger: ambient air flow, cooling air flow, temperature drop.
- 5.5 Compressor: temperature and pressure changes, power required.
- 5.6 Secondary heat exchanger: ambient air flow, cooling airflow, temperature drop.
- 5.7 Turbine: expansion, temperature drop, work extracted.
- 5.8 Mix valve: motor drive, butterflies
- 5.9 Water separator: design, servicing
- 5.10 Temperature controls: cabin sensors, duct sensors, displays, pilot controls

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A T 266L AIRCRAFT AUXILIARY SYSTEMS LABORATORY

5.11 Temp limit sensors: cold limit (e.g. 35 degree F,) Hot limit, (e.g. 190 degree automatic, 240 degree manual).
5.12 System operation: automatic, manual
5.13 System servicing and troubleshooting

6.0 Pressurization Systems
  6.1 Theory of operation: pressure vessel, uncontrolled flow in, controlled flow out.
  6.2 Sources of flow: turbocharger, cabin supercharger, turbocompressor, bleed air
  6.3 Pressure vessel characteristics: contained volume, minimize leaks, seals for wires, cables, fluid lines, round corners on windows and doors, fatigue checks, pressure limits (e.g. 4.5 to 12 P,S,I,D.)
  6.4 Outflow Valve control: pneumatic valve - reference chamber, differential operation, isobaric operation, electrically operated valve: automatic, manual, standby operations. Automatic controls: control of cabin altitude, differential pressure, rate of climb.
  6.5 Safety Valves: pressure relief valves, dump valves, negative pressure relief valves.
  6.6 Operation, servicing and troubleshooting

7.0 Oxygen Systems
  7.1 Oxygen requirements in pressurized and unpressurized aircraft, FAR's 23. 1441, 91.32
  7.2 Types of oxygen systems: low press gas, high press gas, liquid oxygen, chemical oxygen generators.
  7.3 Gaseous oxygen: bottles: HP., LP., DOT 3AA, DOT 3HT, regulators, relief valves, blow-out plugs, distribution lines, control valves, refilling
  7.4 Liquid oxygen: storage container, evaporator, controls, refilling, distribution
  7.5 Chemical oxygen generators: chemical reaction, oxygen output, by-products, starting reaction, distribution of oxygen, heat generated, servicing
  7.6 Operation servicing and troubleshooting of oxygen systems: leak detection, cleaning lines, replacing seals or connections, hydrostatic checking of cylinders.
  7.7 Portable oxygen systems
  7.8 Breathing apparatus: oriface with rebreather bag, diluter/demand masks, pressure demand mask and control.

8.0 Fire Protection - Detection
  8.1 Fire zones: FAR 25.1181 engine, APU, accessory area, cargo, lavatory, wheelwell, combustion heaters, passenger/crew areas
  8.2 Spot detectors: thermoswitch operation, positioning, wiring, warnings (aural, visual) limitations, maintenance, testing

- 8.3 Thermocouple: thermocouple operation, positioning, wiring absolute temperature vs. rate of rise, limitations, testing, servicing
- 8.4 Continuous loop systems: single wire thermistor, twin wire eutectic salt, gas pressure systems. Construction, connections, installation, testing, servicing, repairing, warnings, operation
- 8.5 Smoke detectors: photo, optical, ionization. Operation, testing, servicing.

9.0 Fire Protection - Extinguishing
- 9.1 Theory: cool, remove combustible material, remove oxygen interference with combustion process (i.e. halon).
- 9.2 Classes of fire: A,B,C
- 9.3 Types of extinguishers: Liquid (water), dry chem, gas
- 9.4 Portable extinguishers
- 9.5 Built-in extinguishing systems: for engines, APU, wheel well, lavatories; storage of extinguishant, discharge of bottles (valve, squibb), directing of extinguisher, blow-out plugs
- 9.6 Properties and effects of extinguishing agents: water, Dry chemical, carbon dioxide, Halon 1301, Halon 1211.
- 9.7 Operation of extinguishing systems
- 9.8 Servicing of extinguishing systems: weight, pressure, temperature compensation

10.0 Ice and Rain Control
- 10.1 Overview: types of ice and icing conditions: rime, clear, frost. Effects of ice on thrust, lift, drag, weight, control, stability. Ice prone areas: leading edges, masts, antennas, inlets, probes, windshields, props.
- 10.2 Types of ice control: ground removal, anti-cing, deicing. Antiice/deice systems: thermal, mechanical, chemical.
- 10.3 Thermal deice systems:
  - a. Electrically heated elements: windshields, props, flight controls.
  - b. Components of electric deice systems.
  - c. Inspection and servicing of electric deice systems.
  - d. Hot air deice system.
- 10.4 Mechanical ice removal
  - a. Components and operation: build up and removal of ice, relies on slip stream; upsets airflow over wing, boot inflation.
  - b. Pneumatic deicer inspection, servicing, repair, removal and installation.

- 10.5 Chemical Ice Removal:
  - a. Types: ground, airborne: windshield, props, leading edge.
  - b. Props: supply, pump, control valve, slinger ring, boots, operational considerations, maintenance.
  - c. Weeping leading edge: supply, pump, medium used, control operation, care and maintenance of components
- 10.6 Windshield ice/rain control: windshield wipers, pneumatic air blast, rain repellent.
- 10.7 Miscellaneous deiced components: electric: drain masts, probes, engine inlets, static ports. Hot air: antennas, engine inlets.
- 10.8 Inertial separators.

11.0 Position and Warning Systems

- 11.1 Overview:
  - a. Caution: alert of abnormal situation.
  - b. Warning: requires immediate attention.
  - c. System annunciations: displays condition or mode of operation.
- 11.2 Types of warnings:
  - Visual: lights, flags, CRT, display
  - Aural: bells, clackers, sirens, horns
  - Tactile: stick shaker, rudder shaker, stick pusher.
- 11.3 Conditions requiring warnings: fire, overspeed, stall, improper configuration, ground proximity, autopilot disconnect, low cabin pressure.
- 11.4 Conditions requiring cautions; abnormal system conditions: low temperature, high temperature, overspeed, underspeed, low pressure, high pressure, low voltage, high voltage.
- 11.5 Conditions requiring annunciations:
  - a. Mode select: on/off, up/down, auto, manual, standby, hi/lo, etc.
  - b. Built-in monitoring (status flags): power monitor, signal - valid/invalid, display valid/invalid, display comparisons
- 11.6 Typical display and annunciation systems: sensor - communication - decision - display
- 11.7 Typical annunciation and warning systems: landing gear position, autopilot/flight director mode, configuration warning, takeoff, landing, instrument comparator. system annunciations. Master caution system and caution advisory panels.

A T 266L AIRCRAFT AUXILIARY SYSTEMS LABORATORY

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 ENVIRONMENTAL CONTROL

Instructional Goal Know the reasons for development and the history of development of auxiliary systems on aircraft.

Defined Outcome The student will describe the development of auxiliary systems for use on aircraft and explain the additional comfort, safety and capabilities they provide.

2.0 CABIN HEAT - EXHAUST HEAT EXCHANGERS

Instructional Goal Know the components required and understand the operation and inspection and servicing requirements for exhaust gas heat exchangers.

Defined Outcome The student will describe component and system operation, and remove, inspect, reinstall and test exhaust gas heating systems.

3.0 CABIN HEAT - COMBUSTION HEATER

Instructional Goal Understand system operation, inspection and servicing requirements.

Defined Outcome Students will operate, inspect and service a combustion heater and isolate the causes of system malfunctions given system components and or documentation.

4.0 VAPOR CYCLE AIR CONDITIONING

Instructional Goal Understand properties and methods of heat transfer. Understand the changes of state occurring in a vapor cycle. Understand system operation, inspection and servicing requirements.

Defined Outcome Students will operate, inspect and service a vapor cycle air conditioning system and isolate the causes of system malfunctions given system components and documentation.

5.0 AIR CYCLE AIR-CONDITIONING

Instructional Goal Understand heat transfer properties and temperature and pressure relationships in gases. Understand air cycle system operation, inspection and servicing requirements.

Defined Outcome Students will describe the cooling and heating airflow paths through an air cycle system and define general temperature and pressure conditions at points in the gas path. The students will describe the purpose and operation of flow control values, temperature sensors and control systems used to operate the system. Given documentation and failure symptoms, students will isolate the most probable causes of system failure.

6.0 PRESSURIZATION SYSTEMS

Instructional Goal Understand the reason for pressurization systems on aircraft, their operation and limitations, the components necessary for proper functioning, servicing and inspection requirements and analysis of failures.

Defined Outcome Students will describe the operation of all components of a pressurization system as well as total system operation. They will recognize components and describe their locations on an aircraft. They will correctly determine the most probable causes of system failure given flight crew write-ups, and system documentation.

7.0 OXYGEN SYSTEMS

Instructional Goal Understand the human requirements for supplemental oxygen at altitude and the effects of a deficiency of oxygen on capabilities. Know the most common methods of providing supplemental oxygen to passengers and flight crews and know the operation, servicing and inspection requirements for those systems.

Defined Outcome The students will describe the requirements for supplemental oxygen from a physiological and regulatory standpoint. They will describe the operation of airborne systems that provide supplemental oxygen, the purpose of each component of those systems and the servicing and inspection requirements of each system. They will analyze irregular operation and determine the most probable causes of system malfunctions.

8.0 FIRE PROTECTION - DETECTION

Instructional Goal Understand the causes of airborne fires and the common means of detecting their occurrence. Know the systems and components required to detect fires and the operation of the warning systems that alert flight crews to the occurrence of fires.

Defined Outcome The students will describe causal conditions and locations where fires are likely to occur in aircraft and describe the systems and components that are used to detect their occurrence. Students will explain differences between detection systems, along with inspection and servicing requirements for those systems. Given the proper components and requirements the students will design and build a fire detection system and troubleshoot its malfunctions.

9.0 FIRE PROTECTION - EXTINGUISHING

Instructional Goal Know the agents and equipment used to extinguish fires with airborne equipment, their limitations and their design characteristics, inspection and servicing requirements.

Defined Outcome The student will describe the common methods of fire extinguishing, the agents effectiveness and limitations on the different classes of fires. The student will describe the equipment design characteristics, inspection and servicing requirements.

10.0 ICE AND RAIN CONTROL

Instructional Goal Know the systems used on aircraft external surfaces to control accumulations of ice or rain that could be detrimental to aircraft operation. Understand system operation, limitations and servicing requirements.

Defined Outcome Students will describe the common methods of ice removal and prevention, the systems and components that accomplish this and the operation, servicing and inspection requirements for those systems.

11.0 POSITION AND WARNING SYSTEMS

Instructional Goal Know those conditions that require cautions, warnings and annunciations to a flight crew and those systems that are used to provide the annunciations or warnings or position indications.

Defined Outcome The student will describe those conditions that require annunciations, warnings or cautions, identify the components of annunciation systems that act as sensors, communicators, decision makers and displays and describe their operation. Given the proper components and requirements the students will design, operate and troubleshoot a position indication or warning system.

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VII. PROJECTS

FAA Level

1 1.0 Overview of Environmental Control Systems
Projects as available and applicable.

3 2.0 Cabin Heat - Exhaust Heat Exchangers
Completely disassemble, inspect, pressure check, reassemble and operate an exhaust heat exchanger and all associated exhaust components and record all pertinent information in inspection record and aircraft logbooks.

2 3.0 Cabin Heat - Combustion Heaters
Disassemble, inspect, pressure decay test, reassemble and operate a combustion heater and record all pertinent operational, inspection and discrepancy information in the appropriate records.

2 4.0 Vapor Cycle Air-Conditioning
Depressurize, evacuate, purge, refill leak check and operationally check a vapor cycle air-conditioning system. Record all pertinent inspection and operational information in the appropriate records.

1 5.0 Air Cycle Air-Conditioning
Research assigned aircraft with air cycle system and prepare a diagram showing airflow, control valves, heat exchangers, turbine, compressor, temperature sensors and other operational hardware. Identify servicing requirements for lubrication, filters, water separator etc. Given a set of schematics and abnormal indications identify the probable malfunction in automatic and manual temperature control systems.

1 6.0 Pressurization Systems
Field trip to pressurized aircraft
Projects as available and applicable.

2 7.0 Oxygen Systems
Research and report on oxygen system installation, components operation and servicing for assigned aircraft. Service a high or low pressure gaseous oxygen system in aircraft or mock-up assuring compliance with manufacturers' and Department of Transportation regulations.

3 8.0 Fire Detection
Given the required components and operational information, Design, wire and test a thermoswitch type fire detection system whose operation parallels that of an actual aircraft system.

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Level

9.0 Fire Extinguishing

3 Determine state of charge of (extinguishers containers) by weight and pressure method. Determine causes of extinguisher discharge by observation of blow-out plugs. Perform continuity check of discharge cartridge.

10.0 Ice and Rain Control

2 Install deice boot on leading edge of wing control surface or propeller. Inspect and troubleshoot electric prop deice system. Record all pertinent information in appropriate logbooks.

11.0 Position and Warning System

3 Given system requirements and the proper components design, build and test a landing gear position indicating system whose operation parallels that of an assigned aircraft.

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FAR 147 Appendix B (Gen)

Item	Level	
28	3	Write descriptions of aircraft condition and work performed.
29	3	Complete required maintenance forms, records, and inspection reports.
31	3	Select and use FAA and manufacturers' aircraft maintenance specifications, data sheets, manuals, and publications, and related Federal Aviation Regulations.
32	3	Read Technical Data.

Appendix C (Airframe)

24	2	Check Alignment of Structures.
28	3	Perform airframe conformity and airworthiness inspections.

Appendix D (powerplant)

8	3	Perform powerplant conformity and airworthiness inspections.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: This course provides in-depth coverage of scheduled and non-scheduled aircraft inspections. Information is provided on the regulations governing inspections, the data necessary to perform inspections, inspection techniques, and the forms and records necessary to record the occurrence and findings of inspections. Students participate in planning, researching data and performing complete aircraft inspections (annual and 100 hr) as well as less detailed scheduled and non-scheduled inspections. Classroom troubleshooting is performed by isolating probable faults in aircraft systems based on flight crew failure reports. Troubleshooting procedures and system operations information is obtained from appropriate manufacturers' manuals, wiring diagrams and schematics.

b. Credits: Students receive 3 credits for successful completion of this course.

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c. Hours: The class is scheduled to meet 4 hours per week for fifteen weeks each semester (3600 min.) in class. In addition (4500 min.) outside work is expected for (8100 min.) total student involvement.

d. The 58 hours of instruction accounts for two holidays and is devoted entirely to formal classroom presentations.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab Fees: No lab fees

g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations precede preplanned, structured lab exercises that allow the students to observe and practice the tasks necessary to build skill and confidence in performing aircraft inspections and fault isolation. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of math, physics, aviation publications, and aircraft hardware before entering this course. This working knowledge may be demonstrated in the following ways:

a. Passing the following courses with a grade of C or better.

A T 163	Aircraft Electrical Components
A T 163L	Aircraft Electrical Components Lab.
A T 260	Aircraft Reciprocating Engines
A T 260L	Aircraft Reciprocating Engines Lab
A T 262	Aircraft Turbine Engines
A T 262L	Aircraft Turbine Engines Lab
A T 263	Aircraft Fluid Power Systems
A T 263L	Aircraft Fluid Power Systems Lab

This course must be preceded by or taken concurrently with AT 264, Aircraft Electrical Systems and AT 264L.

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

c. This course must be taken concurrently with AT 267L.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods of makeup are outlined in Appendix B.

b. Class performance will be evaluated by written or oral quizzes or tests and class participation.

c. Final grades for students are computed by averaging grades from tests, homework, reports and class participation.

V. COURSE OUTLINE

1.0 Inspection Basics: Definitions and Examples
  1.1 Scheduled inspections: preflight, daily, annual, 100 hour, periodic, progressive, phased., hot section inspection.
  1.2 Non-scheduled Inspections: hard landing, prop strike, rapid depressurization, severe turbulence, high energy stop, overpressurization, lightning strike, bird strike, overspeed, extreme dust, ice or snow, airworthiness directive required inspection.
  1.3 Other inspections: Byers, damage assessment, post storage.

2.0 Regulations Governing Inspection
  2.1 FAR 91, what inspections must be performed (private).
  2.2 FAR 135 & 121, what inspections must be performed (commercial).
  2.3 FAR 43, performance standards for inspections.
  2.4 FAR 65, persons authorized to perform inspections.
  2.5 FAR 145,inspections by certified repair stations.

3.0 Use of Necessary Data for Inspections
  3.1 FAA specifications and type certificates.
  3.2 Manufacturers' maintenance manual and inspection sheet
  3.3 Illustrated parts catalog
  3.4 Service information (airframe, engine, components)
  3.5 Airworthiness directives
  3.6 Operators' manuals
  3.7 Airworthiness alerts and SDR's (service difficulty reports)

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A T 267 AIRCRAFT INSPECTIONS AND TROUBLESHOOTING

- 4.0 Forms and Records
  - 4.1 Equipment list
  - 4.2 Airworthiness directive requirements
  - 4.3 Airframe and engine maintenance records
  - 4.4 Discrepancy list
  - 4.5 Labor and parts record
  - 4.6 Form 337
  - 4.7 Tracking time/ life limited parts

- 5.0 Inspection Techniques
  - 5.1 Shop technique and mechanic edignite
  - 5.2 Access and cleanliness
  - 5.3 Visual inspections
  - 5.4 NDT inspections
  - 5.5 Operational inspections
  - 5.6 Special test equipment

- 6.0 Reporting Inspection Results
  - 6.1 Maintenance record entries
  - 6.2 Malfunction or defect reports

- 7.0 Reciprocating Engine Troubleshooting
  - 7.1 Fuel system
  - 7.2 Ignition system
  - 7.3 Electrical system (starter, generator, regulator)
  - 7.4 Engine indicating systems
  - 7.5 Engine internal
  - 7.6 Propeller track, balance, vibrating control

- 8.0 Turbine Engine Troubleshooting
  - 8.1 Fuel system (pumps, nozzles, distribution)
  - 8.2 Ignition system
  - 8.3 Electrical system (starter, generator, regulator)
  - 8.4 Engine indicating systems
  - 8.5 Engine internal
  - 8.6 Propeller and rotor systems

- 9.0 Airframe Systems Troubleshooting
  - 9.1 Electrical distribution
  - 9.2 Lighting
  - 9.3 Position and warning systems (indicators, annuniciators)
  - 9.4 Hydraulic systems
  - 9.5 Flight controls
  - 9.6 Other auxiliary systems

- 10.0 Mechanic Certification and Employment
  - 10.1 Time requirements
  - 10.2 Written testing requirements

10.3 Oral and practical testing requirements
10.4 Employment relationships
  a. Job seeking
  b. Employee responsibilities
  c. Lines of authority
  d. Regulatory action and appeals

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 INSPECTION BASICS

Instructional Goal: Know the types of scheduled and non-scheduled inspections performed regularly on aircraft or airborne systems, their value to safe operations and the general factors affecting airworthiness of systems and components inspected.

Defined Outcome: The student will determine the type of inspection to be performed on given aircraft, system or component under given circumstances, accurately describe the findings of that inspection, and correctly determine the airworthiness of the item inspected based on those findings.

2.0 REGULATIONS GOVERNING INSPECTIONS

Instructional Goal: Know what Federal Aviation Regulations (FAR's) apply to the performance of inspections, inspection authority of individuals, requency of inspections and inspections standards.

Defined Outcome: The student will find and quote the proper title, part, section and paragraph of the FAR's that provides an authoritative answer to questions posed about inspections.

3.0 DATA FOR INSPECTION

Instructional Goal: Know the existence, organization and use of government and manufacturer publications that establish inspection criteria.

Defined Outcome: Given access to necessary publications a student will choose the correct manuals and reference all the proper criteria in preparing to perform inspections on aircraft, their systems and components.

4.0 FORMS AND RECORDS

Instructional Goal: Know use of forms and records designed to track aircraft and components' inspection status, time, cycles and airworthiness. Know the required and recommended records and recordkeeping processes.

A T 267 AIRCRAFT INSPECTION AND TROUBLESHOOTING

Defined Outcome: For a given aircraft the student will compile an equipment list, list of alterations, and airworthiness directive listing. The student will also record components and systems inspected and their status, discrepancies found, repairs made, parts used (by manufacturer and part number), time spent on inspection and repairs, and a record of major repairs or alterations on the FAA prescribed Form 337.

5.0 INSPECTION TECHNIQUES

Instructional Goal: Know the proper techniques for inspection of aircraft structure and systems to include but not restricted to: disassembly, cleaning, visual inspection, non-destructive testing, operational tests and use of special test equipment.

Defined Outcomes: The student will properly perform required inspections on assigned aircraft, their systems and components. All discrepancies will be identified regardless of their effect on airworthiness and the aircraft will be returned to its original (preinspection) condition.

6.0 REPORTING INSPECTION RESULTS

Instructional Goal: Know procedures for recording inspection results. Know advantages of sharing inspection findings through malfunction or defect reports, airworthiness alerts and service difficulty reports.

Defined Outcomes: The student will list inspection results including all discrepancies and the status (airworthy or unairworthy) of the aircraft, systems or components inspected. All findings of potential interest to other operators will be submitted to the FAA on Form 8010-4.

7.0 RECIPROCATING ENGINE TROUBLESHOOTING

Instructional Goal: Know proper operation of airframe and powerplant systems and subsystems, determine existence of malfunctions in those systems, isolate to the component level the cause of each malfunction, and recommend or perform corrective action.

Defined Outcome: Given an aircraft or simulated aircraft system the student will determine if it is operating properly, and if a malfunction exists the student will isolate the cause of that malfunction and initiate corrective action.

A T 267 AIRCRAFT INSPECTIONS AND TROUBLESHOOTING

8.0 TURBINE ENGINE TROUBLESHOOTING

Instructional Goal: Know proper operation of airframe and powerplant systems and subsystems, determine existence of malfunctions in those systems, isolate to the component level the cause of each malfunction, and recommend or perform corrective action.

Defined Outcome: Given an aircraft or simulated aircraft system the student will determine if it is operating properly, and if a malfunction exists the student will isolate the cause of that malfunction and initiate corrective action.

9.0 AIRFRAME SYSTEMS TROUBLESHOOTING

Instructional Goal: Know proper operation of airframe and powerplant systems and subsystems, determine existence of malfunctions in those systems, isolate to the component level the cause of each malfunction, and recommend or perform corrective action.

Defined Outcome: Given an aircraft or simulated aircraft system the student will determine if it is operating properly, and if a malfunction exists the student will isolate the cause of that malfunction and initiate corrective action.

10.0 MECHANIC CERTIFICATION AND EMPLOYMENT

Instructional Goal Know the testing and cetification procedures required to obtain the FAA mechanic's certificate with an airframe or powerplant rating.

Defined Outcome The student will describe the steps necessary to obtain a mechanic's certificate from the FAA, the time limits involved and the options available.

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A T 267L AIRCRAFT INSPECTIONS AND TROUBLESHOOTING LABORATORY

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FAR 147 Appendix B (Gen)

Item	Level	
28	3	Write descriptions of aircraft condition and work performed.
29	3	Complete required maintenance forms, records, and inspection reports.
31	3	Select and use FAA and manufacturers' aircraft maintenance specifications, data sheets, manuals, and publications, and related Federal Aviation Regulations.
32	3	Read Technical Data.

Appendix C (Airframe)

Item	Level	
24	2	Check Alignment of Structures.
28	3	Perform airframe conformity and airworthiness inspections.

Appendix D (powerplant)

Item	Level	
8	3	Perform powerplant conformity and airworthiness inspections.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: This course provides in-depth coverage of scheduled and non-scheduled aircraft inspections. Information is provided on the regulations governing inspections, the data necessary to perform inspections, inspection techniques, and the forms and records necessary to record the occurrence and findings of inspections. Students participate in planning, researching data and performing complete aircraft inspections (annual and 100 hr) as well as less detailed scheduled and non-scheduled inspections. Classroom troubleshooting is performed by isolating probable faults in aircraft systems based on flight crew failure reports. Troubleshooting procedures and system operations information is obtained from appropriate manufacturers' manuals, wiring diagrams and schematics.

b. Credits: Students receive 2 credits for successful completion of this course.

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c. Hours: The class is scheduled to meet 6 hours per week for fifteen weeks each semester (5400 min.) in class. In addition (1800 min.) outside work is expected for (7200 min.) total student involvement.

d. The 87 hours of instruction accounts for two holidays and is devoted entirely to lab exercises.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab Fees: Lab fees for this course are outlined in appendix A.

g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations in the accompanying lecture class precede preplanned, structured lab exercises that allow the students to observe and practice the tasks necessary to build skill, and self-confidence in performing aircraft inspections and fault isolation. Students isolate system faults on actual aircraft and powerplants and on simulated aircraft systems, using flight crew reports, manufacturers' manuals, and test equipment to determine failure causes and recommend corrective action. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of math, physics, aviation publications, and aircraft hardware before entering this course. This working knowledge may be demonstrated in the following ways:

a. Passing the following courses with a grade of C or better.

A T 163	Aircraft Electrical Components
A T 163L	Aircraft Electrical Components Lab.
A T 260	Aircraft Reciprocating Engines
A T 260L	Aircraft Reciprocating Engines Lab
A T 262	Aircraft Turbine Engines
A T 262L	Aircraft Turbine Engines Lab
A T 263	Aircraft Fluid Power Systems
A T 263L	Aircraft Fluid Power Systems Lab

This course must be preceded by or taken concurrently with AT 264, Aircraft Electrical Systems and AT 264L.

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b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

c. This course must be taken concurrently with AT 267.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods of makeup are outlined in Appendix B.

b. Class performance will be evaluated by written or oral quizzes or tests and class participation.

c. Final grades for students are computed by averaging grades from tests, homework, reports and class participation.

V. COURSE OUTLINE

1.0 Inspection Basics: Definitions and Examples
    1.1 Scheduled Inspections: preflight, daily, annual, 100 hour, periodic, progressive, phased., hot section inspection.
    1.2 Non-scheduled Inspections: hard landing, prop strike, rapid depressurization, severe turbulence, high energy stop, overpressurization, lightning strike, bird strike, overspeed, extreme dust, ice or snow, airworthiness directive required inspection.
    1.3 Other inspections: Byers, damage assessment, post storage.

2.0 Regulations Governing Inspection
    2.1 FAR 91, what inspections must be performed (private).
    2.2 FAR 135 & 121, what inspections must be performed (commercial).
    2.3 FAR 43, performance standards for inspections.
    2.4 FAR 65, persons authorized to perform inspections.
    2.5 FAR 145, inspections by certified repair stations.

3.0 Use of Necessary Data for Inspections
    3.1 FAA specifications and type certificates.
    3.2 Manufacturers' maintenance manual and inspection sheet
    3.3 Illustrated parts catalog
    3.4 Service information (airframe, engine, components)
    3.5 Airworthiness directives
    3.6 Operators' manuals
    3.7 Airworthiness alerts and SDR's (service difficulty reports).

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A T 267L AIRCRAFT INSPECTIONS AND TROUBLESHOOTING LABORATORY

- 4.0 Forms and Records
  - 4.1 Equipment list
  - 4.2 Airworthiness directive requirements
  - 4.3 Airframe and engine maintenance records
  - 4.4 Discrepancy List
  - 4.5 Labor and Parts Record
  - 4.6 Form 337
  - 4.7 Tracking time/ life limited parts

- 5.0 Inspection Techniques
  - 5.1 Shop technique and mechanic edignite
  - 5.2 Access and cleanliness
  - 5.3 Visual inspections
  - 5.4 NDT inspections
  - 5.5 Operational inspections
  - 5.6 Special test equipment

- 6.0 Reporting Inspection Results
  - 6.1 Maintenance record entries
  - 6.2 Malfunction or defect reports

- 7.0 Reciprocating Engine Troubleshooting
  - 7.1 Fuel system
  - 7.2 Ignition system
  - 7.3 Electrical system (starter, generator, regulator)
  - 7.4 Engine indicating systems
  - 7.5 Engine internal
  - 7.6 Propeller track, balance, vibrating control

- 8.0 Turbine engine Troubleshooting
  - 8.1 Fuel system (pumps, nozzles, distribution)
  - 8.2 Ignition System
  - 8.3 Electrical system (starter, generator, regulator)
  - 8.4 Engine indicating systems
  - 8.5 Engine internal
  - 8.6 Propeller and rotor systems

- 9.0 Airframe Systems Troubleshooting
  - 9.1 Electrical distribution
  - 9.2 Lighting
  - 9.3 Position and warning systems (indicators, annuniciators)
  - 9.4 Hydraulic systems
  - 9.5 Flight controls
  - 9.6 Other auxiliary systems

- 10.0 Mechanic Certification and Employment
  - 10.1 Time requirements
  - 10.2 Written testing requirements

10.3 Oral and practical testing requirements
10.4 Employment relationships
  a. Job seeking
  b. Employee responsibilities
  c. Lines of authority
  d. Regulatory action and appeals

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 INSPECTION BASICS

Instructional Goal: Know the types of scheduled and non-scheduled inspections performed regularly on aircraft or airborne systems, their value to safe operations and the general factors affecting airworthiness of systems and components inspected.

Defined Outcome: The student will determine the type of inspection to be performed on given aircraft, system or component under given circumstances, accurately describe the findings of that inspection, and correctly determine the airworthiness of the item inspected based on those findings.

2.0 REGULATIONS GOVERNING INSPECTIONS

Instructional Goal: Know what Federal Aviation Regulations (FAR's) apply to the performance of inspections, inspection authority of individuals, frequency of inspections and inspections standards.

Defined Outcome: The student will find and quote the proper title, part, section and paragraph of the FAR's that provides an authoritative answer to questions posed about inspections.

3.0 DATA FOR INSPECTION

Instructional Goal: Know the existence, organization and use of government and manufacturer publications that establish inspection criteria.

Defined Outcome: Given access to necessary publications a student will choose the correct manuals and reference all the proper criteria in preparing to perform inspections on aircraft, their systems and components.

4.0 FORMS AND RECORDS

Instructional Goal: Know use of forms and records designed to track aircraft and components' inspection status, time, cycles and airworthiness. Know the required and recommended records and record-keeping processes.

A T 267L AIRCRAFT INSPECTIONS AND TROUBLESHOOTING LABORATORY

Defined Outcome: For a given aircraft the student will compile an equipment list, list of alterations, and Airworthiness Directive listing. The student will also record components and systems inspected and their status, discrepancies found, repairs made, parts used (by manufacturer and part number), time spent on inspection and repairs, and a record of major repairs or alterations on the FAA prescribed Form 337.

5.0 INSPECTION TECHNIQUES

Instructional Goal: Know the proper techniques for inspection of aircraft structure and systems to include but not restricted to: disassembly, cleaning, visual inspection, non-destructive testing, operational tests and use of special test equipment.

Defined Outcomes: The student will properly perform required inspections on assigned aircraft, their systems and components. All discrepanies will be identified regardless of their effect on airworthiness and the aircraft will be returned to its original (preinspection) condition.

6.0 REPORTING INSPECTION RESULTS

Instructional Goal: Know procedures for recording inspection results. Know advantages of sharing inspection findings through malfunction or defect reports, airworthiness alerts and service difficulty reports.

Defined Outcomes: The student will list inspection results including all discrepancies and the status (airworthy or unairworthy) of the aircraft, systems or components inspected. All findings of potential interest to other operators will be submitted to the FAA on Form 8010-4.

7.0 RECIPROCATING ENGINE TROUBLESHOOTING

Instructional Goal: Know proper operation of airframe and powerplant systems and subsystems, determine existence of malfunctions in those systems, isolate to the component level the cause of each malfunction, and recommend or perform corrective action.

Defined Outcome: Given an aircraft or simulated aircraft system the student will determine if it is operating properly, and if a malfunction exists the student will isolate the cause of that malfunction and initiate corrective action.

A T 267L AIRCRAFT INSPECTIONS AND TROUBLESHOOTING LABORATORY

8.0 TURBINE ENGINE TROUBLESHOOTING

Instructional Goal: Know proper operation of airframe and powerplant systems and subsystems, determine existence of malfunctions in those systems, isolate to the component level the cause of each malfunction, and recommend or perform corrective action.

Defined Outcome: Given an aircraft or simulated aircraft system the student will determine if it is operating properly, and if a malfunction exists the student will isolate the cause of that malfunction and initiate corrective action.

9.0 AIRFRAME SYSTEMS TROUBLESHOOTING

Instructional Goal: Know proper operation of airframe and powerplant systems and subsystems, determine existence of malfunctions in those systems, isolate to the component level the cause of each malfunction, and recommend or perform corrective action.

Defined Outcome: Given an aircraft or simulated aircraft system the student will determine if it is operating properly, and if a malfunction exists the student will isolate the cause of that malfunction and initiate corrective action.

10.0 MECHANIC CERTIFICATION AND EMPLOYMENT

Instructional Goal Know the testing and certification procedures required to obtain the FAA Mechanic's certificate with an airframe and powerplant rating.

Defined Outcome The student will describe the steps necessary to obtain a mechanic's certificate from the FAA, the time limits involved and the options available.

VII. OUTLINE - PROJECTS

FAA Level	
	1.0 Inspection Basics:
3	Research required material.
	2.0 Regulations Governing Inspections
3	Research required material.
	3.0 Data for Inspections
3	Research required material.

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FAA Level

4.0 Aircraft Records

3 4.1 Use type certificate data sheets to determine if a given aircraft, engine or propeller conforms to its certified condition. Insure presence of all required equipment and note any alterations that exist.

4.2 Complete a detailed equipment list for a given aircraft. Include make, model, part number and serial number for engine, propeller aircraft, engine accessories e.g. magnetos, carburetors, starter, generator, regulator, vacuum pump, air filter, turbo, propeller governor, etc., radios, instruments and equipment. Also include date and aircraft time of installation and recommended time between overhauls (TBO's) for each component.

4.3 Research airworthiness directives (AD's) and list those that may apply to given aircraft, engine, or prop, equipment, radios, instruments or general components. Use aircraft records and actual aircraft and components to determine applicability and compliance with AD's.

5.0 Inspections

3 5.1 Complete preflight inspection of a given aircraft in accordance with manufacturers' recommendations. Start and taxi aircraft and perform complete run-up, noting all pertinent engine operational parameters including: static RPM, idle RPM, mag drop, oil pressure, oil temperature, fuel flow, manifold pressure, electric system indications, idle mixture indications, tach accuracy, CHT, EGT at various power settings, gyro and flight instrument operation.

5.2 Clean aircraft and remove access panels in preparation for a complete aircraft inspection (100 hour or annual).

5.3 Perform designated portions of a complete aircraft inspection on aircraft, engine and components keeping a record of inspected items on an inspection checklist and inspection results on a discrepancy sheet.

6.0 Reporting of Inspection Results

3 6.1 Students will compile completed records of inspections performed and the results of those inspections to reflect complete aircraft condition.

7.0 Reciprocating Engine Troubleshooting

2 7.1 Determine the cause of faults in the ignition systems such as: broken P-lead, shorted high tension lead, arcing outlet block, burned points, improper mag to engine timing, improper firing sequence, improper internal mag timing.

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FAA Level

7.2 Determine the cause of faults in the fuel system such as: sunken carb float, restricted fuel line, blocked carb bowl vent, plugged carb oriface, leaking induction gasket, improper mixture control, improper throttle control, blocked screen, leaking or blocked selector valve, water contamination, leaking primer.
7.3 Determine the cause of faults in the engine electrical power system such as: shorted field, grounded field, open field, open master solenoid, open starter solenoid, worn brushes, open regulator, shorted regulator, belt slipping.
7.4 Determine the cause of faults in the engine indicating instrument systems such as: tachometer, fuel flow, oil temperature oil pressure, manifold pressure, CHT, EGT, carburetor air temperature, fuel quantity.
7.5 Determine the cause of propeller vibration or pitch control faults.

8.0 Turbine Engine Troubleshooting
8.1 Determine the cause of failures in the ignition system.
2 8.2 Determine the cause of failures in the fuel system.
8.3 Determine the cause of failures in the electrical power system.
8.4 Determine the cause of failures in the engine indicating system.

9.0 Airframe Systems Troubleshooting: Determine the cause of failure and isolate the faulty component in the following types of systems.
2
9.1 Electrical distribution
9.2 Lighting
9.3 Position and warning systems
9.4 Hydraulics systems
9.5 Flight controls
9.6 Auxiliary systems

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A T 268 FUNDAMENTALS OF AIRCRAFT WELDING, COVERING AND FINISHING

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FAR 147 APPENDIX B (GENERAL)

ITEM	LEVEL	
18	3	Inspect and check welds.

APPENDIX C (AIRFRAME)

ITEM	LEVEL	
4	1	Select and apply fabric and fiberglass covering materials.
5	3	Inspect, test, and repair fabric and fiberglass.
6	1	Apply trim letters and touchup paint.
7	2	Identify and select aircraft finishing materials.
8	2	Apply paint and dope.
9	2	Inspect finishes and identify defects.
17	1	Weld magnesium and titanium.
18	1	Solder stainless steel.
19	1	Fabricate tubular structures.
20	2	Solder, braze, gas weld and arc weld steel.
21	2	Weld aluminum and stainless steel.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Beginning with historical background, the student will be exposed to the theory of and techniques used in the tubular steel structures, aircraft dope and fabric procedures and paint systems.

b. Credits: Students will receive 1 credit for successful completion of this course.

c. Hours: This course is scheduled to meet 2 hours per week for fifteen weeks each semester (1800 min.) in class. In addition (1800 min.) of outside work is expected for total student involvement of (3600 min.).

d. The 29 hours of instruction accounts for two holidays and is devoted entirely to classroom presentations.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab fees: No lab fees.

g. This course, in conjunction with the AMT curriculum prepares an individual for entry level positions in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations will precede preplanned, structured lab exercises that are presented in the accompanying laboratory courses and allow the students to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance functions on traditional aircraft structures. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of aviation publications, and aircraft materials and processes before entering this course. This working knowledge may be demonstrated in the following ways:

a. Passing the following courses or their equivalent with a grade of "C" or better:

A T 160 Aircraft Information, Regulations and Procedures

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

c. This course must be taken concurrently with AT 268L Fundamentals of Aircraft Welding, Covering and Finishing.

IV. EVALUATION

a. Class attendance is mandatory. Effects of absences and methods for makeup are outlined in Appendix B.

b. Class performance will be evaluated by written or oral examinations.

V. COURSE OUTLINE

0.0 Safety procedures for metal working and torch usage

1.0 Welding
  1.1 General terminology
  1.2 Types of welding processes
  1.3 Safety procedures

A T 268 FUNDAMENTALS OF AIRCRAFT WELDING, COVERING AND FINISHING

- 1.4 Equipment and facilities
- 1.5 Materials required

2.0 Oxygen-Acetylene Welding without Filler Rod
- 2.1 Procedure use of equipment
- 2.2 Safety precautions
- 2.3 Welding basics
- 2.4 Temperatures of molten metal
- 2.5 Puddle formation and penetration

3.0 Oxygen-Acetylene Welding with Filler Rod
- 3.1 Welding procedures
- 3.2 Weld bead formation and penetration and inspection.
- 3.3 Determining airworthiness welds
- 3.4 Inside sleeve splice
- 3.5 Fabrication procedures for cluster welding

4.0 Oxygen-Acetylene Cutting
- 4.1 Equipment and safety precautions
- 4.2 Torch cutting use
- 4.3 Metal cutting procedure
- 4.4 Plate cutting

5.0 Brazing
- 5.1 Equipment and components
- 5.2 Procedures and applications
- 5.3 Puddle manipulation
- 5.4 Determining airworthiness

6.0 Other Welding Processes
- 6.1 ARC
- 6.2 Shielded ARC
- 6.3 Soldering
- 6.4 Magnesium, aluminum, stainless steel

7.0 Aircraft Fabrics
- 7.1 Terminology
- 7.2 Quality and strength requirements
- 7.3 Natural fiber
- 7.4 Synthetic
- 7.5 Testing

8.0 Miscellaneous Fabric Materials
- 8.1 Reinforcing tape
- 8.2 Sewing thread
- 8.3 Rib Lacing cord
- 8.4 Special fasteners
- 8.5 Surface tape

A T 268 FUNDAMENTALS OF AIRCRAFT WELDING, COVERING AND FINISHING

- 9.0 Dopes and Doping Processes
  - 9.1 General and terminology
  - 9.2 Doping processes
  - 9.3 Techniques of application
  - 9.4 Doping problems

- 10.0 Applying Fabric Covering
  - 10.1 General
  - 10.2 Material selection
  - 10.3 Aircraft structure preparation
  - 10.4 Dope proofing
  - 10.5 Chafe points
  - 10.6 Inter-rib lacing
  - 10.7 Plywood preparation
  - 10.8 Covering methods and practices
  - 10.9 Fabric seams
  - 10.10 Reinforcing tape
  - 10.11 Ribstitching
  - 10.12 Surface tape

- 11.0 Seams
  - 11.1 Sewn seams
  - 11.2 Doped seams

- 12.0 Wing Covering
  - 12.1 General and terminology
  - 12.2 Covering methods
  - 12.3 Rib stitching
  - 12.4 Alternate fabric attachment methods
  - 12.5 Anti-tear strips and surface tape

- 13.0 Fuselage Covering
  - 13.1 General
  - 13.2 Fuselage lacing
  - 13.3 Tightening fabric, compound curves

- 14.0 Drain and Inspection Openings
  - 14.1 General
  - 14.2 Ventilation and drain grommets
  - 14.3 Inspection openings
  - 14.4 Inspection procedures

- 15.0 Fabric and Dope Deterioration
  - 15.1 General
  - 15.2 Mildew
  - 15.3 Sunlight
  - 15.4 Dope acidity
  - 15.5 Dope contamination
  - 15.6 Storage conditions

A T 268 FUNDAMENTALS OF AIRCRAFT WELDING, COVERING AND FINISHING

- 16.0 Fabric Repairs
    - 16.1 General
    - 16.2 Damage, (tears)
    - 16.3 Sewed patch repair
    - 16.4 Doped patch repair
    - 16.5 Panel repair

- 17.0 Painting Systems
    - 17.1 General
    - 17.2 History and economics of major systems
    - 17.3 Purpose and paint application of major systems

- 18.0 Paint Stripping
    - 18.1 Purpose of stripping
    - 18.2 Types of strippers
    - 18.3 Application of stripper
    - 18.4 Cleaning procedures

- 19.0 Metal Conditioners
    - 19.1 Purpose of metal etching
    - 19.2 Types of conditioners
    - 19.3 Applying metal conditioners
    - 19.4 Shop safety precautions

- 20.0 Primers
    - 20.1 Purpose of primers
    - 20.2 Surface preparation
    - 20.3 Types of primers
    - 20.4 Applying Primers
    - 20.5 Contamination prevention

- 21.0 Topcoats
    - 21.1 General
    - 21.2 Major topcoat systems
    - 21.3 Applying topcoats
    - 21.4 Waxing and cleaning

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 - 3.0 WELDING

Instructional Goal Know welding terminology, general applications of welding, the major types of welding processes and welding safety precautions.

Defined Outcome Students will define welding terms, describe the major applications of welding and processes. Students will demonstrate and describe safety precautions associated with a welding shop.

Instructional Goal Know the basics of oxygen-acetylene welding, temperatures of melting metal, and puddle formation.

A T 268 FUNDAMENTALS OF AIRCRAFT WELDING, COVERING AND FINISHING

Defined Outcome Students will define the basics of oxygen-acetylene welding, demonstrate knowledge and skill of molten metal puddle manipulation and describe welding safety precautions.

Instructional Goal Know the aspects of an airworthy weld, how to fabricate an inner sleeve splice and a cluster joint.

Defined Outcome Students will demonstrate skill and knowledge in determining an airworthy weld, and describe the fabrication procedure for an inner sleeve splice and a cluster joint.

4.0 METAL CUTTING TORCH

Instructional Goal Know cutting torch equipment, its proper use in metal plate cutting, and safety precautions.

Defined Outcome Students will demonstrate skill and knowledge in plate steel cutting and shop safety precautions.

5.0 BRAZING

Instructional Goal Know brazing equipment, brazing procedures, puddle manipulation, and assess airworthiness of brazing.

Defined Outcome Students will demonstrate the use of brazing equipment, and show skill and knowledge in brazing procedures, and determine airworthiness of a brazed joint.

6.0 OTHER WELDING PROCESSES

Instructional Goal Be familiar with ARC and shielded arc welding, soldering and joining aluminum, stainless steel and magnesium.

Defined Outcome Students will describe arc and shielded arc welding and soldering and select the proper procedure for joining stainless steel, aluminum on a magnesium.

7.0 - 8.0 AIRCRAFT FABRICS

Instructional Goal Know fabric terminology, quality, and strength requirements and the two categories of fabric.

Defined Outcome Students will show how to determine fabric quality, strength, and type.

Instructional Goal Know the purpose of all the applicable miscellaneous fabric materials.

A T 268 FUNDAMENTALS OF AIRCRAFT WELDING, COVERING AND FINISHING

Defined Outcome Students will define the purpose of those items considered miscellaneous fabric materials, and demonstrate their skill and knowledge in applying them to a fabric covered surface.

9.0 AIRCRAFT DOPE

Instructional Goal Know the terminology applicable to dopes, and dope processes, the techniques of applying dope and how to cure doping problems.

Defined Outcome Students will define dope terminology and processes. Students will demonstrate the correct technique in dope application and how to resolve dope application problems.

10.0 - 14.0 FABRIC APPLICATION

Instructional Goal Understand fabric selection, airframe preparation and dope proofing before fabric covering. Know basic covering methods for seams, reinforcing, and surface tapes and rib stitching.

Defined Outcome Students will describe how to determine type and grade of fabric for covering. Demonstrate skill in dope proofing, fabric covering, fabricating covering seams, installing reinforcing tape, rib stitching and surface tape following approved procedures.

Instructional Goal Recognize and understand, covering methods of fuselage and wings including rib stitching and the installation of inspection and drain fixtures.

Defined Outcome Students will demonstrate skill and knowledge in covering a surface in an airworthy manner up through the finish coat.

15.0 DOPE AND FABRIC DETERIORATION

Instructional Goal Know the effects on fabric of mildew, ultraviolet rays, dope acidity and contamination.

Defined Outcome Students will describe and identify fabric mildew, sunlight deterioration, dope contamination, and the approved methods of preventing these items.

16.0 FABRIC REPAIRS

Instructional Goal Know the difference between a major and a minor repair of fabric. Know how to perform a sewed or doped patch repair and a doped panel repair.

A T 268 FUNDAMENTALS OF AIRCRAFT WELDING, COVERING AND FINISHING

Defined Outcome Students will show knowledge and skill in performing a minor doped repair and describe how to make a sewn minor repair, and a panel repair.

17.0 PAINTING SYSTEMS

Instructional Goal Recognize, and understand the primary purpose of painting systems and how they are applied. Know the historical, and economical aspects of the major painting systems.

Defined Outcome Students will describe the advantages and disadvantages of the major painting systems and how they are applied.

18.0 - 19.0 STRIPPING AND CONDITIONING

Instructional Goal Know the purpose of stripping, the types, and application of strippers and cleaning procedures. Know metal conditioners, their purpose and how to apply them.

Defined Outcome Students will safely apply a stripper to a painted surface, clean the surface and apply a conditioner to prepare the surface for priming.

20.0 - 21.0 PRIMER AND TOPCOAT SYSTEMS

Instructional Goal Know the purpose of primer and topcoat systems, the major types of systems, how to apply primers and topcoats and prevent system contamination.

Defined Outcome Students will demonstrate knowledge and skill in the selection and application of a primer and a topcoat paint system.

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A T 268L FUNDAMENTALS OF AIRCRAFT WELDING, COVERING AND FINISHING LAB

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FAR 147 APPENDIX B (GENERAL)

ITEM	LEVEL	
18	3	Inspect and check welds.

APPENDIX C (AIRFRAME)

ITEM	LEVEL	
4	1	Select and apply fabric and fiberglass covering materials.
5	3	Inspect, test, and repair fabric and fiberglass.
6	1	Apply trim letters and touchup paint.
7	2	Identify and select aircraft finishing materials.
8	2	Apply paint and dope.
9	2	Inspect finishes and identify defects.
17	1	Weld magnesium and titanium.
18	1	Solder stainless steel.
19	1	Fabricate tubular structures.
20	2	Solder, braze, gas weld and arc weld steel.
21	2	Weld aluminum and stainless steel.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Beginning with historical background, the student will be exposed to the theory of and techniques used in the tubular steel structures, aircraft dope and fabric procedures and paint systems.

b. Credits: Students will receive 2 credits for successful completion of this course.

c. Hours: This course is scheduled to meet 5 hours per week for fifteen weeks each semester (4500 min.) in class. In addition (900 min.) of outside work is expected for total student involvement of (5400 min.).

d. The 72 hours of instruction accounts for two holidays and is devoted entirely to laboratory exercises.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

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f. Lab Fees: Lab fees for this course are outlined in appendix A.

g. This course, in conjunction with the AMT curriculum prepares an individual for entry level positions in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations in the accompanying lecture course precedes preplanned, structured lab exercises that allow the students to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance functions in traditional aircraft structures. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of aviation publications, and aircraft materials and processes before entering this course. This working knowledge may be demonstrated in the following ways:

a. Passing the following courses or their equivalent with a grade of "C" or better:

A T 160 Aircraft Information, Regulations and Procedures

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

c. This course must be taken concurrently with AT 268L Fundamentals of Aircraft Welding, Covering and Finishing.

IV. EVALUATION

a. Class attendance is mandatory. Effects of absences and methods for makeup are outlined in Appendix B.

b. Class performance will be evaluated by written or oral examinations.

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A T 268L FUNDAMENTALS OF AIRCRAFT WELDING, COVERING AND FINISHING LAB
V. COURSE OUTLINE

- 1.0 Welding
    - 1.1 General terminology
    - 1.2 Types of welding processes
    - 1.3 Safety procedures
    - 1.4 Equipment and facilities
    - 1.5 Materials required

- 2.0 Oxygen-Acetylene Welding without Filler Rod
    - 2.1 Procedure use of equipment
    - 2.2 Safety precautions
    - 2.3 Welding basics
    - 2.4 Temperatures of molten metal
    - 2.5 Puddle formation and penetration

- 3.0 Oxygen-Acetylene Welding with Filler Rod
    - 3.1 Welding procedures
    - 3.2 Weld bead formation and penetration and inspection.
    - 3.3 Determining airworthiness welds
    - 3.4 Inside sleeve splice
    - 3.5 Fabrication procedures for cluster welding

- 4.0 Oxygen-Acetylene Cutting
    - 4.1 Equipment and safety precautions
    - 4.2 Torch cutting use
    - 4.3 Metal cutting procedure
    - 4.4 Plate cutting

- 5.0 Brazing
    - 5.1 Equipment and components
    - 5.2 Procedures and applications
    - 5.3 Puddle manipulation
    - 5.4 Determining airworthiness

- 6.0 Other Welding Processes
    - 6.1 ARC
    - 6.2 Shielded ARC
    - 6.3 Soldering
    - 6.4 Magnesium, aluminum, stainless steel

- 7.0 Aircraft Fabrics
    - 7.1 Terminology
    - 7.2 Quality and strength requirements
    - 7.3 Natural fiber
    - 7.4 Synthetic
    - 7.5 Testing

- 8.0 Miscellaneous Fabric Materials
    - 8.1 Reinforcing tape
    - 8.2 Sewing thread
    - 8.3 Rib Lacing cord
    - 8.4 Special fasteners
    - 8.5 Surface tape

A T 268L FUNDAMENTALS OF AIRCRAFT WELDING, COVERING AND FINISHING LAB

9.0 Dopes and Doping Processes
  9.1 General and terminology
  9.2 Doping processes
  9.3 Techniques of application
  9.4 Doping problems

10.0 Applying Fabric Covering
  10.1 General
  10.2 Material selection
  10.3 Aircraft structure preparation
  10.4 Dope proofing
  10.5 Chafe points
  10.6 Inter-rib lacing
  10.7 Plywood preparation
  10.8 Covering methods and practices
  10.9 Fabric seams
  10.10 Reinforcing tape
  10.11 Ribstitching
  10.12 Surface tape

11.0 Seams
  11.1 Sewn seams
  11.2 Doped seams

12.0 Wing Covering
  12.1 General and terminology
  12.2 Covering methods
  12.3 Rib stitching
  12.4 Alternate fabric attachment methods
  12.5 Anti-tear strips and surface tape

13.0 Fuselage Covering
  13.1 General
  13.2 Fuselage lacing
  13.3 Tightening fabric, compound curves

14.0 Drain and Inspection Openings
  14.1 General
  14.2 Ventilation and drain grommets
  14.3 Inspection openings
  14.4 Inspection procedures

15.0 Fabric and Dope Deterioration
  15.1 General
  15.2 Mildew
  15.3 Sunlight
  15.4 Dope acidity
  15.5 Dope contamination
  15.6 Storage conditions

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16.0 Fabric Repairs
  16.1 General
  16.2 Damage, (tears)
  16.3 Sewed patch repair
  16.4 Doped patch repair
  16.5 Panel repair

17.0 Painting Systems
  17.1 General
  17.2 History and economics of major systems
  17.3 Purpose and paint application of major systems

18.0 Paint Stripping
  18.1 Purpose of stripping
  18.2 Types of strippers
  18.3 Application of stripper
  18.4 Cleaning procedures

19.0 Metal Conditioners
  19.1 Purpose of metal etching
  19.2 Types of conditioners
  19.3 Applying metal conditioners
  19.4 Shop safety precautions

20.0 Primers
  20.1 Purpose of primers
  20.2 Surface preparation
  20.3 Types of primers
  20.4 Applying primers
  20.5 Contamination prevention

21.0 Topcoats
  21.1 General
  21.2 Major topcoat systems
  21.3 Applying topcoats
  21.4 Waxing and cleaning

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 - 3.0 WELDING

Instructional Goal Know welding terminology, general applications of welding, the major types of welding processes and welding safety precautions.

Defined Outcome Students will define welding terms, describe the major applications of welding and processes. Students will demonstrate and describe safety precautions associated with a welding shop.

Instructional Goal Know the basics of oxygen-acetylene welding, temperatures of melting metal, and puddle formation.

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Defined Outcome Students will define the basics of oxygen-acetylene welding, demonstrate knowledge and skill of molten metal puddle manipulation and describe welding safety precautions.

Instructional Goal Know the aspects of an airworthy weld, how to fabricate an inner sleeve splice and a cluster joint.

Defined Outcome Students will demonstrate skill and knowledge in determining an airworthy weld, and describe the fabrication procedure for an inner sleeve splice and a cluster joint.

4.0 METAL CUTTING TORCH

Instructional Goal Know cutting torch equipment, its proper use in metal plate cutting, and safety precautions.

Defined Outcome Students will demonstrate skill and knowledge in plate steel cutting and shop safety precautions.

5.0 BRAZING

Instructional Goal Know brazing equipment, brazing procedures, puddle manipulation, and assess airworthiness of brazing.

Defined Outcome Students will demonstrate the use of brazing equipment, and show skill and knowledge in brazing procedures, and determine airworthiness of a brazed joint.

6.0 OTHER WELDING PROCESSES

Instructional Goal Be familiar with ARC and shielded arc welding, soldering and joining aluminum, stainless steel and magnesium.

Defined Outcome Students will describe arc and shielded arc welding and soldering and select the proper procedure for joining stainless steel, aluminum on a magnesium.

7.0 - 8.0 AIRCRAFT FABRICS

Instructional Goal Know fabric terminology, quality, and strength requirements and the two categories of fabric.

Defined Outcome Students will show how to determine fabric quality, strength, and type.

Instructional Goal Know the purpose of all the applicable miscellaneous fabric materials.

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Defined Outcome Students will define the purpose of those items considered miscellaneous fabric materials, and demonstrate their skill and knowledge in applying them to a fabric covered surface.

9.0 AIRCRAFT DOPE

Instructional Goal Know the terminology applicable to dopes, and dope processes, the techniques of applying dope and how to cure doping problems.

Defined Outcome Students will define dope terminology and processes. Students will demonstrate the correct technique in dope application and how to resolve dope application problems.

10.0 - 14.0 FABRIC APPLICATION

Instructional Goal Understand fabric selection, airframe preparation and dope proofing before fabric covering. Know basic covering methods for seams, reinforcing, and surface tapes and rib stitching.

Defined Outcome Students will describe how to determine type and grade of fabric for covering. Demonstrate skill in dope proofing, fabric covering, fabricating covering seams, installing reinforcing tape, rib stitching and surface tape following approved procedures.

Instructional Goal Recognize and understand, covering methods of fuselage and wings including rib stitching and the installation of inspection and drain fixtures.

Defined Outcome Students will demonstrate skill and knowledge in covering a surface in an airworthy manner up through the finish coat.

15.0 DOPE AND FABRIC DETERIORATION

Instructional Goal Know the effects on fabric of mildew, ultraviolet rays, dope acidity and contamination.

Defined Outcome Students will describe and identify fabric mildew, sunlight deterioration, dope contamination, and the approved methods of preventing these items.

16.0 FABRIC REPAIRS

Instructional Goal Know the difference between a major and a minor repair of fabric. Know how to perform a sewed or doped patch repair and a doped panel repair.

Defined Outcome Students will show knowledge and skill in performing a minor doped repair and describe how to make a sewn minor repair, and a panel repair.

17.0 PAINTING SYSTEMS

Instructional Goal Recognize, and understand the primary purpose of painting systems and how they are applied. Know the historical, and economical aspects of the major painting systems.

Defined Outcome Students will describe the advantages and disadvantages of the major painting systems and how they are applied.

18.0 - 19.0 STRIPPING AND CONDITIONING

Instructional Goal Know the purpose of stripping, the types, and application of strippers and cleaning procedures. Know metal conditioners, their purpose and how to apply them.

Defined Outcome Students will safely apply a stripper to a painted surface, clean the surface and apply a conditioner to prepare the surface for priming.

20.0 - 21.0 PRIMER AND TOPCOAT SYSTEMS

Instructional Goal Know the purpose of primer and topcoat systems, the major types of systems, how to apply primers and topcoats and prevent system contamination.

Defined Outcome Students will demonstrate knowledge and skill in the selection and application of a primer and a topcoat paint system.

VII. PROJECTS

FAA Level

1.0 Welding
- 1.1 Puddle manipulation without filler rod (6" wide plate)
- 2 1.2 Puddle manipulation with filler rod (6" wide plate)
- 1.3 Weld overlapp joining. (6" wide plate)
- 1.4 Braze overlapp joining (6" wide plate)
- 1.5 Assess airworthiness of weld (inner sleeve splice and cluster weld).
- 1.6 Oxygen-Acetylene cutting torch , cut plate.
- 1.7 Inspection and testing (destructive and non-destructive) of welds and welded structures.

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FAA Level	
	2.0 Dope and Fabric
	2.1 Surface
	a. Dope proof
2	b. Fabric application
	c. Tensioning
	d. Dope application
	e. Drain grommet and inspection ring applications
	f. Rib stitch
	g. Surface tape application
	h. Silver and color application
	2.2 Fabric repair: doped on for 6" tear
	a. Finish determination and preparation
	b. Patch application
	c. Tensioning
	d. Dope application
	e. Surface tape application
	f. Finish
3	2.3 Inspect fabric cover
	3.0 Painting
	3.1 Aircraft panel (approx. 10 sq.ft.)
	a. Strip paint
2	b. Metal etch panel (condition)
	c. Prime panel (undercoat)
	d. Apply topcoat (finish)

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

c. This course must be taken concurrently with AT 264.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for make-up are outlined in Appendix B.

b. Class performance is evaluated by written and oral quizzes or tests, class participation and written reports.

c. Final grades for students are computed by averaging marks for participation and technique on assigned projects. This includes research of documentation, project planning, use of tools, safety, efficiency, thoroughness and records of project results.

V. OUTLINE

1.0 INSTRUMENT BASICS.
- 1.1 Types of systems: mechanical, electro mechanical, hydro-mechanical, electronic
- 1.2 System components: sensor, communication, display
- 1.3 System considerations: accuracy, repeatability, response to airborne environment (vibration, heat, voltage fluctuations), calibration, maintenance, fault annunciation (self test), display quality, readability, (size, color, stability etc.), power requirements

2.0 SENSOR TYPES: SENSE HEAT, PRESSURE, POSITION, FLOW.
- 2.1 Mechanical sensors: flaps, airflow, angle of attack (AOA), gravity, (slip/skid), mechanical followers (actuator handles, cables/pulley, cam follower), gyros
- 2.2 Hydro-mechanical sensors: pressure bulb (temperature) diaphragm, aneroid, manometer. (pressure)
- 2.3 D.C. electro-mechanical (electrical response to mechanical input): potentiometer, carbon pile, tach generator, strain gauge, accelerometer, Hall effect
- 2.4 D.C. electro thermal: thermistor, bimetalic switch, thermocouple
- 2.5 A.C. electro-mechanical: E-coil, synchro, resolver, linear variable differential transformer (LVDT), piezoelectric crystal, laser, doppler (flow), capacitance fluid quantity
- 2.6 A.C. electro-thermal: crystal
- 2.7 Digital sensors
- 2.8 Photo-optical: photo-cell, photo-transistor

3.0 DATA COMMUNICATIONS

- 3.1 Mechanical: pulley and cable, gears, cam follower
- 3.2 Hydro-mechanical: instrument tubing
- 3.3 D.C. electric: 1 or 2 wire
- 3.4 A.C. electric: 1,2,3,4 wire
- 3.5 Multiplexing
- 3.6 Digital bus: one direction, 2 direction, 2 wire, 3 wire, 4 wire
- 3.7 Accuracy
- 3.8 Faults, integrity checks and failure effects

4.0 COMPUTATION OPERATIONS ON RAW DATA

- 4.1 Mechanical - gears, bellcranks, levers, cams
- 4.2 Hydro-mechanical - diaphragms, springs, pressure leaks
- 4.3 D.C. electric-resistor networks, pots, amplifiers
- 4.4 A.C. electric - pot, amp, VCO, C.T.
- 4.5 Digital - MP, storage, arithmetic

5.0 INFORMATION USERS

- 5.1 Displays
  - a. Mechanical
  - b. Hydro-mechanical
  - c. Electrical AC scope, CRT, synchro
  - d. Electrical DC LCD, LED, meter movement
  - e. Digital CRT, LCD, CED
- 5.2 Controls - command - response
  - a. Mechanical and electro-mechanical
  - b. Electro-hydraulic
  - c. Digital
  - d. Servo system basics
- 5.3 Caution and warning systems
  - a. Mechanical
  - b. Electric/electro-mechanical
  - c. Digital

6.0 COMPLETE INFORMATION (INSTRUMENT) SYSTEMS

- 6.1 Mechanical: e.g. Angle of Attack, slip-skid, flap position (cessna 150), trim position (cub), float gauge gyro instruments (D.G. artificial Horizon)
- 6.2 Hydro-mechanical: e.g. engine oil pressure, oil temperature altimeter, airspeed, VSI
- 6.3 D.C. electric: potentiometer/voltmeter, thermocouple, D.C. servo. e.g. float/POT fuel quantity, flap position (cessna 172), EGT
- 6.4 A.C. electric: LVDT, synchro, tach generator, wheelspeed transducer, AC servo
- 6.5 Digital: TAT/EPRL (total air temperature, engine pressure ratio limit), air data computer, electronic engine control

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7.0 TRANSMITTERS AND RECEIVERS
- 7.1 Fundamentals:
  - a. Intercom: transducer-amplifier - communication lines - transducer
  - b. Transceiver: transducer, amplifier, coding, transmission, propagation, reception, amplifying, decoding, transducing
- 7.2 Input Transducer: movement/sound to electrical current
- 7.3 Amplifier: going lower power to high power
- 7.4 Coding: AM, FM, pulse
- 7.5 Transmission: RF amp, antennas, speed, wavelength, frequency, impedance matching
- 7.6 Propagation: electro-magnetic wave, ground wave, reflected waves, frequency characteristics, FCC allotted frequencies, information content, sidebands, spectrum
- 7.7 Reception: magnetic coupling, electric coupling, receive antenna
- 7.8 Decoding: tuners, sensitivity, selectivity, filters, mixing, oscillators
- 7.9 Output transducer: signal to sound, signal to distance, signal to bearing

8.0 COMMUNICATION SYSTEMS
- 8.1 Intercom, flight interphone, service interphone, passenger address
- 8.2 VHF commmunications
- 8.3 HF communications
- 8.4 ACARS
- 8.5 Audio integrating

9.0 NAVIGATION SYSTEMS: BASIC OPERATION AND USE
- 9.1 Pitot static
- 9.2 Magnetic compass
- 9.3 ADF
- 9.4 VOR
- 9.5 DME
- 9.6 ATC
- 9.7 ILS, LOC and GS
- 9.8 LRRA, (low range radio altimeter).
- 9.9 Attitude information
- 9.10 IRS, (inertial reference system).
- 9.11 Flight director
- 9.12 Performance data/flight management
- 9.13 Autopilot
- 9.14 VLF, LORAN, OMEGA
- 9.15 Marker beacon

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10.0 INTEGRATED AVIONICS SYSTEMS
- 10.1 Flight management
- 10.2 EICAS
- 10.3 Performance data computer
- 10.4 Flight and maintenance data recording

11.0 BUILT IN TEST
- 11.1 VOR test
- 11.2 Self checks
- 11.3 Condition annunciators (flags)
- 11.4 BITE routines
  1. meter and sequence
  2. auto with go/no go
  3. auto with readouts

12.0 AVIONICS INSTALLATIONS
- 12.1 Panel mounted instruments
- 12.2 Panel mounted radios
- 12.3 Remote boxes
- 12.4 Connectors: cylindical, flat, Arinc 404, Arinc 600, rack connectors.
- 12.5 Wiring: single, twisted, shielding, coax.
- 12.6 Equipment cooling: convection, suction, fans, forced air, air-conditioning.
- 12.7 Antennas: structural, interference, spacing, orientation, bonding, connections.

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

0.0 REVIEW

Instructional Goal: Refamiliarize students with electrical fundamentals, components and data that will be utilized in the course.

Defined Outcome: Students will describe and recognize components, processes and data used in aircraft electronic systems.

1.0 INSTRUMENT BASICS

Instructional Goal: Understand the reasons for and the methods of achieving remote sensing of information and displaying that information.

Defined Outcomes: Students will identify instrument system components on a block diagram level and identify those components that sense the environment, convert information, communicate information and display information and analyze the important factors of complete instrument systems. i.e. accuracy, readability power requirements etc..

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2.0 SENSOR TYPES

Instructional Goal: Understand the types of sensors available, what they are used to sense and what other system components they must be matched with.

Defined Outcomes: The student will identify sensors of different types, analyze their operation and combine sensors with other components to create working instrument systems.

3.0 DATA COMMUNICATIONS

Instructional Goal: Understand the various methods of communicating information from one location to another and the advantages and disadvantages of each.

Defined Outcomes: The student will analyze different data communication concepts, discuss their limitations and their appropriateness for airborne applications.

4.0 COMPUTATION OPERATIONS

Instructional Goal: Understand how mechanical and electronic devices can be incorporated to perform computations on data used in instrument systems.

Defined Outcomes: The student will choose the proper computational method to be used on a given type of data in a defined instrument system.

5.0 INFORMATION USERS

Instructional Goal: Understand how displays, control systems and warning systems use remotely obtained information.

Defined Outcomes: The student will identify what information must be provided to allow the above systems to properly perform their function and will give a general description of how that information is processed in each system.

6.0 COMPLETE INFORMATION SYSTEMS

Instructional Goal: To understand the proper operation, failure modes, necessary maintenance and testing methods of typical complete airborne instrument systems.

Defined Outcomes: Given example airborne instrument systems the student will analyze the function of each component of that system and research and outline from the manufacturers' information, the above factors for those systems.

7.0 TRANSMITTERS AND RECEIVERS

Instructional Goal: Understand the basic operation and necessary components of AM and FM Transceivers and the natural phenomena that allow their use.

Defined Outcomes: Students will reproduce block diagrams of AM and FM pulse transceivers and identify the operation of their major components, and define signal condition at identifiable points in the transmit or receive process.

8.0 COMMUNICATION SYSTEMS

Instructional Goals: To understand the use of various types of airborne communication techniques.

Defined Outcomes: Students will identify which type of airborne communication system would best meet a given set of requirements.

9.0 NAVIGATION SYSTEMS

Instructional Goal: To understand the use of various types of airborne navigation systems.

Defined Outcomes: Students will identify which type of airborne navigation system would best meet a given set of requirements. Students will describe the operation and display available from various airborne navigation systems.

10.0 INTEGRATED AVIONICS

Instructional Goal: To create an awareness of the degree of integration of navigation, communication and instrument systems in aircraft.

Defined Outcomes: Students will identify those systems on given aircraft that integrate information from several sources and explain the means of integration and the advantages of integration.

11.0 BUILT IN TEST

Instructional Goal: To identify the advantages and limitations of on-board test equipment for avionics equipment and give some examples of BITE operation.

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Defined Outcomes: The students will identify those systems that are equipped with BITE and explain the operation of that equipment.

12.0 AVIONICS INSTALLATIONS

Instructional Goal: To understand and become skilled at the proper procedures for installation of navigation, communication and instrument systems including box and instrument mounting, wiring, fluid connections, antenna installations, cooling equipment.

Defined Outcomes: Students will demonstrate installation of navigation, communication and instrument systems including box and instrument mounting and wiring, fluid connections, antenna installations, coax installations, shock mounting and electrical bonding.

VII. OUTLINE PROJECTS

FAA Level

2 0.0 Review of ATA 100, wiring diagrams, solid state components, logic and microprocessors.

1 1.0 INSTRUMENT BASICS: Projects as available and appropriate.

2.0 SENSORS
- 2.1 Test accuracy of hydro-mechanical temperature sensor e.g. oil temperature system for light aircraft. 2
- 2.2 Test accuracy of tach generator.
- 2.3 Test accuracy of thermocouple system
- 2.4 Show voltage, phase relationships for synchro or E.coil sensors at various positions.

3.0 DATA COMMUNICATIONS:
- 3 3.1 Check and rig mechanical position indicator.
- 3.2 Check integrity and operations of pitot-static tubing.
- 3.3 Check integrity of AC and DC electric indicator wiring.
- 2 3.4 Check waveform and information content of digital pulse train, e.g. Arinc 429, Mil-Std-1553, ASCB.
- 3.6 Observe and measure effects of EMI on various instrument communication systems.

4.0 COMPUTATION OPERATIONS: Projects as available and appropriate.
1

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Level

5.0 INFORMATION USERS

3 5.1 Identify components and operation of mechanisms in instrument displays.

5.2 Observe and assure proper operation of servo systems.

5.3 Observe and interpret displays of caution and warning annunciators.

6.0 COMPLETE INFORMATION SYSTEMS

3

6.1 Check operation and accuracy of mechanical instrument system.

6.2 Check operation and accuracy of hydro-mechanical instrument system. Perform pitot-static check on aircraft in accordance with FAR parts 91, 43 and manufacturer's maintenance manual.

6.3 Determine accuracy and resolution of synchro instrument system.

6.4 Test and service complete vacuum driven gyro system.

7.0 TRANSMITTERS AND RECEIVERS

2 7.1 a. Observe signal frequencies and amplitude at various points in an intercom system.

7.1 b. Observe signals frequencies and amplitudes at various points in a com transceiver.

7.2 Use ramp test equipment to determine transmitted power and VSWR for various installations.

7.3 Perform ramp test on VOR system using local VOT facility.

7.4 Perform ramp test on VOR, LOC, GS and MKR BCN system using portable ramp test equipment.

8.0 COMMUNICATIONS

8.1 Install and operate a portable intercom system.

3

9.0 NAVIGATION SYSTEMS

1 9.1 Use ramp test equipment and local test transmitters to check accuracy of navigational radios installed in aircraft.

9.2 Check operation of autopilot and flight director installed on various aircraft in accordance with manufacturers' instructions.

9.3 Observe self checks, engagement and disengagement of autopilot system.

1 10.0 INTEGRATED AVIONICS: Projects as available or applicable.

1 11.0 BUILT IN TEST EQUIPMENT

11.1 Perform LOC, GS, MKR BCN, flight director or autopilot tests using built in test equipment.

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FAA Level

12.0 AVIONICS INSTALLATIONS

3 12.1 Install panel mounted instruments (round and square).
12.2 Install panel mounted radios.
12.3 Install remote avionics components.
12.4 Wire and install in-line, rack, and panel connectors.
12.5 Install and terminate aircraft wires of the following types: single, twisted pairs, shielded wires, coax.
12.6 Install an aircraft antenna.

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A T 265 AIRCRAFT BONDED STRUCTURES
60 HOURS

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FAR 147 APPENDIX C (Airframe)

Item	Level	
1	1	Service and repair wood structures.
2	2	Identify wood defects.
3	2	Inspect wood structures.
11	2	Inspect bonded structures.
12	2	Inspect and repair plastics, honeycombs, and laminated structures.
13	2	Inspect, check, service and repair windows, doors, and interior furnishings.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Beginning with historical background, the student will be taught the theory of and techniques used in the fabrication, inspection and repair of bonded structures. Areas covered include plastics, wood structures, honeycomb structures, and advanced composite structures.

b. Credits: Students will receive 3 credits for successful completion of the course.

c. Hours: The course is scheduled to meet 4 hours per week for fifteen weeks each semester (3600 min.) in class. In addition (4500 min.) of outside work is expected for total student involvement of (8100 min.).

d. The 60 hours of instruction accounts for two holidays and is devoted entirely to formal classroom presentations.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab fees: No lab fees.

g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions in the aviation maintenance field.

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A T 265 AIRCRAFT BONDED STRUCTURES

II. ACTIVITIES

Formal lecture and demonstrations will precede preplanned, structured lab exercises that are presented in the accompanying laboratory course and allow the students to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance functions on bonded structures. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

a. Must be taken concurrently with AT 265L, Bonded Structures Laboratory.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for make-up are outlined in Appendix B.

b. Class performance will be evaluated by written or oral examinations.

V. OUTLINE

1.0 Introduction
    1.1 Plastic and composite development history.
    1.2 Current plastic and composite applications.
    1.3 Plastic and composite terminology.

2.0 Wood Structures as Composites
    2.1 Service and repair of wood structures.
    2.2 Identify wood defects.
    2.3 Inspection of wood structures.

3.0 Plastic Enclosures
    3.1 Inspection and repair of plastic enclosures.
        a. Windows
        b. Doors
        c. Furnishings

4.0 Characteristics of Advanced Composites
    4.1 Properties of materials
        a. Resin matrix
        b. Reinforcing materials
        c. Fasteners
        d. Core materials e.g. honey comb, solid

- 4.2 Assembly
  - a. Cleanliness e.g. inclusions, contaminants
  - b. Ply orientation
  - c. Resin systems
  - d. Bagging and heat
  - e. Cure time
- 4.3 Bonding techniques
  - a. Wet lay-up
  - b. Bagging
  - c. Two part mold
  - d. Porosity
- 4.4 Specifications
  - a. Process specs
  - b. Material specs
  - c. Piece specs
- 4.5 Material controls
  - a. Refrigeration
  - b. Humidity
- 4.6 Loads
  - a. Primary
  - b. Secondary
- 4.7 Design guides
  - a. Safety factors
  - b. Material selection
  - c. Process selection

5.0 Composite Processes

- 5.1 Inspection of assemblies
  - a. Dimensional
  - b. Bond
  - c. Cure
- 5.2 Bond line defects
  - a. Resisn content
  - b. Foreign matter
  - c. Film thickness
- 5.3 NDI techniques
  - a. Ultra-sonic material defects
  - b. "Coin tap"
  - c. X-ray
- 5.4 Material defects
  - a. Debonding
  - b. Improper cure
  - c. Improper storage
- 5.5 Effects of chemicals
  - a. Chemical cleaner
  - b. Painting systems
  - c. Fuels
- 5.6 Environmental agents
  - a. Ultraviolet light
  - b. Infrared light
  - c. Surface heating
  - d. Age

- 5.7 Damage tolerances
  - a. Impact
  - b. Overloading
  - c. Abrasion
  - d. Notching
- 5.8 Lightning strike
  - a. Heat damage
  - b. Conductivity
  - c. Inlaid conductors

6.0 Field Inspection and Repair

- 6.1 Facilities and equipment and data
  - a. Hot bond equipment
  - b. Ultra-sonic
  - c. Vacuum equipment
- 6.2 Inspection criteria
  - a. Bond failures
  - b. Fabric failures
  - c. Matrix failures
- 6.3 Materials and alternatives
- 6.4 Field repairs
  - a. Wet lay- up
  - b. Vacuum bagging

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 INTRODUCTION

Instructional Goal: Know the history, contemporary applications and terminology associated with plastics and composites.

Defined Outcomes: The student will describe the history of plastics and composites. He will enumerate contemporary applications and will use plastic and composite terminology.

2.0 WOOD STRUCTURE AS COMPOSITES

Instructional Goal: Know the service and inspection procedures for wood structures.

Defined Outcomes: The student will inspect and correctly identify defects in wood structures.

3.0 PLASTIC ENCLOSURES

Instructional Goal: Know the inspection and repair procedures for plastic enclosures.

Defined Outcomes: The student will describe the repair procedures for windows, doors and furnishings.

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A T 265 AIRCRAFT BONDED STRUCTURES

4.0 CHARACTERISTICS OF ADVANCED COMPOSITES

Instructional Goal: Know the effects of outside forces as composite structures and the design features for coping with them.

Defined Outcomes: The students will describe how outside forces affect composite structures and design features for coping with them.

5.0 COMPOSITE PROCESSES

Instructional Goal: Know the process for assembling and testing composite parts and pieces.

Defined Outcomes: The student will describe the process for assembling and testing composite parts and pieces.

6.0 FIELD INSPECTION AND REPAIR

Instructional Goal: Know the process for field inspection and repair of composite structures.

Defined Outcomes: The student will describe the process for field inspection and repair of composite structures.

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APPROVED
09.04.87 Betty M. Rogers
Date Signature

A T 265L AIRCRAFT BONDED STRUCTURES LABORATORY

at265lab.kw

FAR 147 APPENDIX C (Airframe)

Item	Level	
1	1	Service and repair wood structures.
2	2	Identify wood defects.
3	2	Inspect wood structures.
11	2	Inspect bonded structures.
12	2	Inspect and repair plastics, honeycombs, and laminated structures.
13	2	Inspect, check, service and repair windows, doors, and interior furnishings.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Beginning with historical background, the student will develop skills in the techniques used for fabrication, inspection and repair of bonded structures. Areas covered include plastics, wood structures, honeycomb structures and advanced composite structures.

b. Credits: Students will receive 2 credits for successful completion of the course.

c. Hours: The course is scheduled to meet 4 hours per week for fifteen weeks each semester (3600 min.) in class. In addition (1800 min.) outside work is expected for total student involvement of (5400 min.).

d. The 56 hours of instruction accounts for two holidays and is devoted entirely to laboratory exercises.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab fees: Fees for this course are outlined in appendix "A".

g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions in the aviation maintenance field.

A T 265L AIRCRAFT BONDED STRUCTURES LABORATORY

II. ACTIVITIES

Formal lecture and demonstrations in the accompanying lecture course precedes preplanned, structured lab exercises that allow the students to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance functions on bonded structures. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

a. Must be taken concurrently with AT 265, Bonded Structures Lecture.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for makeup are outlined in Appendix B.

b. Class performance will be evaluated by written or oral examinations.

V. OUTLINE

1.0 Introduction
    1.1 Plastic and composite development history.
    1.2 Current plastic and composite applications.
    1.3 Plastic and composite terminology.

2.0 Wood Structures as Composites
    2.1 Service and repair of wood structures.
    2.2 Identify wood defects.
    2.3 Inspection of wood structures.

3.0 Plastic Enclosures
    3.1 Inspection and repair of plastic enclosures.
        a. Windows
        b. Doors
        c. Furnishings

4.0 Characteristics of Advanced Composites
    4.1 Properties of materials
        a. Resin matrix
        b. Reinforcing materials
        c. Fasteners
        d. Core materials e.g. honey comb, solid

AT 265L AIRCRAFT BONDED STRUCTURES LABORATORY

- 4.2 Assembly
  - a. Cleanliness e.g. inclusions, contaminants
  - b. Ply orientation
  - c. Resin systems
  - d. Bagging and heat
  - e. Cure time
- 4.3 Bonding techniques
  - a. Wet lay-up
  - b. Bagging
  - c. Two part mold
  - d. Porosity
- 4.4 Specifications
  - a. Process specs
  - b. Material specs
  - c. Piece specs
- 4.5 Material controls
  - a. Refrigeration
  - b. Humidity
- 4.6 Loads
  - a. Primary
  - b. Secondary
- 4.7 Design guides
  - a. Safety factors
  - b. Material selection
  - c. Process selection

5.0 Composite Processes

- 5.1 Inspection of assemblies
  - a. Dimensional
  - b. Bond
  - c. Cure
- 5.2 Bond line defects
  - a. Resisn content
  - b. Foreign matter
  - c. Film thickness
- 5.3 NDI techniques
  - a. Ultra-sonic Material defects
  - b. "Voin tap"
  - c. X-ray
- 5.4 Material defects
  - a. Debonding
  - b. Improper cure
  - c. Improper storage
- 5.5 Effects of chemicals
  - a. Chemical cleaner
  - b. Painting systems
  - c. Fuels
- 5.6 Environmental agents
  - a. Ultraviolet light
  - b. Infrared light
  - c. Durface heating
  - d. Age

- 5.7 Damage tolerances
    - a. Impact
    - b. Overloading
    - c. Abrasion
    - d. Notching
- 5.8 Lightning strike
    - a. Heat damage
    - b. Conductivity
    - c. Inlaid conductors

6.0 Field Inspection and Repair

- 6.1 Facilities and equipment and data
    - a. Hot bond equipment
    - b. Ultra-sonic
    - c. Vacuum equipment
- 6.2 Inspection criteria
    - a. Bond failures
    - b. Fabric failures
    - c. Matrix failures
- 6.3 Materials and alternatives
- 6.4 Field repairs
    - a. Wet lay-up
    - b. Vacuum bagging

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 INTRODUCTION

Instructional Goal Know the history, contemporary applications and terminology associated with plastics and composites.

Defined Outcomes The student will describe the history of plastics and composites. He will enumerate contemporary applications and will use plastic and composite terminology.

2.0 WOOD STRUCTURE AS COMPOSITES

Instructional Goal Service and inspect wood structures.

Defined Outcome The student will inspect and identify defects in wood structures.

3.0 PLASTIC ENCLOSURES

Instructional Goal Inspect and repair plastic enclosures.

Defined Outcomes: The student will repair windows, doors and furnishings.

A T 265L AIRCRAFT BONDED STRUCTURES LABORATORY

4.0 CHARACTERISTICS OF ADVANCED COMPOSITES

Instructional Goal: Know the effects of outside forces on composite structures and the design features for coping with them.

Defined Outcomes: The students will observe how outside forces affect composite structures and note design features for coping with them.

5.0 COMPOSITE PROCESSES

Instructional Goal: Know the process for assembling and testing composite parts and pieces.

Defined Outcomes: The student will assemble and test composite parts and pieces.

6.0 FIELD INSPECTION AND REPAIR

Instructional Goal: Field inspection and repair of composite structures.

Defined Outcomes: The student will perform field inspection and repair of composite structures.

VII. PROJECTS

FAA Level		
1	1.0	Projects as available and appropriate
2	2.0	Inspect a wood structure for damage and defects. Select suitable wood for use in repairs.
3	3.0	Perform a bonded repair to a clear acrylic enclosure. Clean and remove scratches from acrylic.
1	4.0	Projects as available and appropriate.
2	5.0	Make a mold and mold a composite part using a vacuum bag process.
2	6.0	a. Repair an aluminum faced "Honeycomb" part. b. Repair an epoxy laminate faced cored part. c. Repair a non-cored composite laminate. d. Assist in using a hot bond machine in making a composite repair. e. Make an ultrasonic inspection of representative composite parts.

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09-04-89 Betty M. Rogers
Date Signature

A T 266 AIRCRAFT AUXILIARY SYSTEMS

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FAR 147 APPENDIX C (AIRFRAME)

ITEM	LEVEL	
33	1	Repair heating, cooling, air-conditioning, pressurization and oxygen system components.
34	1	Inspect, check, troubleshoot, service and repair heating, airconditioning, cooling and pressurization systems.
35	2	Inspect, check, troubleshoot, service and repair oxygen systems.
49	3	Install, service check airframe electrical wiring, switches, controls, indicators and protective devices.
51	1	Inspect, check and service, speed and takeoff warning systems, electrical brake controls and anti-skid systems.
52	3	Inspect, check, troubleshoot, service, and repair landing gear position indicating and warning systems.
53	2	Inspect, check, troubleshoot, service and repair airframe ice and rain control systems.
54	1	Inspect, check, and service smoke and carbon monoxide detection systems.
55	3	Inspect, check, service, troubleshoot and repair aircraft fire detection and extinguishing systems.

APPENDIX D (POWERPLANT)

ITEM	LEVEL	
11	3	Inspect, check, service, troubleshoot and repair engine fire detection and extinguishing systems.
33	1	Inspect, check, service and repair propeller synchronizing and ice control systems.

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09-04-87 Betty M Rogers
Date Signature

A T 266 AIRCRAFT AUXILIARY SYSTEMS

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: This course covers operation, maintenance, servicing, inspection and troubleshooting of auxiliary systems on aircraft. These are systems that are not required to power or control an aircraft in flight but do enhance safety, improve comfort, or extend capabilities of the aircraft. They include environmental control systems (heat, air-conditioning, pressurization, oxygen), ice and rain control systems, fire protection and position indicating and warning systems.

b. Credits: Students receive 3 credits for successful completion of this course.

c. Hours: This course is scheduled to meet 4 hours per week for fifteen weeks for a total of (3600 min.) in class. In addition (4500 min.) outside work is expected for total student involvement of (8100 min.).

d. The 58 hours of instruction accounts for two holidays and is devoted entirely to formal classroom presentations.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab Fees: No lab fees.

g. This course, in conjunction with the AMT curriculum, prepares a student for entry level position in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations in this course precede preplanned, structured lab exercises in the accompanying laboratory course and allow the students to observe and practice the tasks necessary to build skill and confidence in operating and performing the required maintenance functions on auxiliary systems and their components. Emphasis will be placed on electrical control of mechanical systems and troubleshooting techniques for those systems. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of physics, electricity and aircraft maintenance practices before entering this course. This working knowledge may be demonstrated in the following ways:

A T 266 AIRCRAFT AUXILIARY SYSTEMS

a. Passing of the following courses, or their equivalent with a grade of C or better:

A T 160 Aircraft Information, Regulations and Procedures
A T 161 Aircraft Assembly
A T 161L Aircraft Assembly Lab
A T 264 Aircraft Electrical Systems
A T 264L Aircraft Electrical Systems Lab

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

c. This course must be taken concurrently with AT 266L Auxiliary Systems Lab.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for make up are listed in Appendix B.

b. Class performance is evaluated by means of written or oral tests and quizzes and class participation.

V. OUTLINE

1.0 Environmental Control Systems - Overview and History of Development
  1.1 Heating: exhaust heat exchangers, combustion heaters, compressors/bleed air.
  1.2 Cooling: vapor cycle airconditioning, air cycle air conditioning.
  1.3 Pressurization: FAR's for pressurization and Oxygen, extended capabilities of pressurized aircraft.
  1.4 Oxygen: gaseous HP and LP (high pressure and low pressure), liquid oxygen, chemical generators

2.0 Cabin Heat - Exhaust Heat Exchangers
  2.1 Exhaust gas flow
  2.2 Heated air flow
  2.3 Heat exchanger (baffles, surface area, temperature differential).
  2.4 Heated air control - cabin/carburetor
  2.5 Factors affecting cabin heat (system design, OAT, power setting, airspeed)
  2.6 Inspecting and servicing cabin heat systems (heat muff inspection, valves and actuating cables, flight deck CO check, cabin heat airworthiness directives).

3.0 Cabin Heat - Combustion Heaters
  3.1 Fuel system: supply, valves, press control, pumps, low press and wick, high press and nozzle, safety valve, drain valve.

3.2 Ignition: glow plug, high tension plug and exciter
3.3 Combustion Liner: design, materials, integrity checks
3.4 Combustion air flow
3.5 Ventilating air flow
3.6 Operation
3.7 Electrical control and schematics
3.8 Inspection, servicing, airworthiness directives.

4.0 Vapor Cycle Air-Conditioning
4.01 Theory of operation: heat of compression, vaporization, condensation
4.1 Compressor: engine driven, electric motor driven, clutch, RPM range power required, pressure at input and output, lubrication.
4.2 Condenser: location, airflow, refrigerant flow, pressure
4.3 Receiver dryer.
4.4 Expansion valve: oriface, thermostatic control, compensation for evaporator size
4.5 Evaporator: position, design, internal pressure, airflow
4.6 Operation: temperature and pressures in cycle.
4.7 Servicing: evacuating, purging, charging, lubrication, leak check.
4.8 Repairing: water in lines, slugging compressor, slipping belts, clutches, checking and adding lubricant.

5.0 Air Cycle Air-conditioning
5.1 Theory of operation: heat of compression, heat of expansion, heat exchangers, mixing air flows
5.2 Air source: bleed air, turbo-compressor, roots blower
5.3 Filters and shutoff valves (sov): source, cross bleed
5.4 Primary heat exchanger: ambient air flow, cooling air flow, temperature drop.
5.5 Compressor: temperature and pressure changes, power required.
5.6 Secondary heat exchanger: ambient air flow, cooling airflow, temperature drop.
5.7 Turbine: expansion, temperature drop, work extracted.
5.8 Mix valve: motor drive, butterflies
5.9 Water separator: design, servicing
5.10 Temperature controls: cabin sensors, duct sensors, displays, pilot controls
5.11 Temp limit sensors: cold limit (e.g. 35 degree F,) Hot limit, (e.g. 190 degree automatic, 240 degree manual).
5.12 System operation: automatic, manual
5.13 System servicing and troubleshooting

- 6.0 Pressurization Systems
  - 6.1 Theory of operation: pressure vessel, uncontrolled flow in, controlled flow out.
  - 6.2 Sources of flow: turbocharger, cabin supercharger, turbocompressor, bleed air
  - 6.3 Pressure vessel characteristics: contained volume, minimize leaks, seals for wires, cables, fluid lines, round corners on windows and doors, fatigue checks, pressure limits (e.g. 4.5 to 12 PSID.)
  - 6.4 Outflow Valve control: pneumatic valve - reference chamber, differential operation, isobaric operation, electrically operated valve: automatic, manual, standby operations. automatic controls: control of cabin altitude, differential pressure, rate of climb.
  - 6.5 Safety Valves: pressure relief valves, dump valves, negative pressure relief valves.
  - 6.6 Operation, servicing and troubleshooting

- 7.0 Oxygen Systems
  - 7.1 Oxygen requirements in pressurized and unpressurized aircraft, FAR's 23. 1441, 91.32
  - 7.2 Types of Oxygen systems: low press gas, high press gas, liquid oxygen, chemical oxygen generators.
  - 7.3 Gaseous oxygen: bottles: HP., LP., DOT 3AA, DOT 3HT, regulators, relief valves, blow-out plugs, distribution lines, control valves, refilling
  - 7.4 Liquid oxygen: storage container, evaporator, controls, refilling, distribution
  - 7.5 Chemical oxygen generators: chemical reaction, oxygen output, by-products, starting reaction, distribution of oxygen, heat generated, servicing
  - 7.6 Operation servicing and troubleshooting of oxygen systems: leak detection, cleaning lines, replacing seals or connections, hydrostatic checking of cylinders.
  - 7.7 Portable oxygen systems
  - 7.8 Breathing apparatus: oriface with rebreather bag, diluter/demand masks, pressure demand mask and control.

- 8.0 Fire Protection - Detection
  - 8.1 Fire zones: FAR 25.1181 engine, APU, accessory area, cargo, lavatory, wheelwell, combustion heaters, passenger/crew areas
  - 8.2 Spot detectors: thermoswitch operation, positioning, wiring, warnings (aural, visual) limitations, maintenance, testing
  - 8.3 Thermocouple: thermocouple operation, positioning, wiring absolute temperature vs. rate of rise, limitations, testing, servicing
  - 8.4 Continuous loop systems: single wire thermistor, twin wire eutectic salt, gas pressure systems. Construction, connections, installation, testing, servicing, repairing, warnings, operation

8.5 Smoke detectors: photo, optical, ionization. Operation, testing, servicing.

9.0 Fire Protection - Extinguishing
- 9.1 Theory: cool, remove combustible material, remove oxygen interference with combustion process (i.e. halon).
- 9.2 Classes of fire: A,B,C
- 9.3 Types of extinguishers: Liquid (water), dry chem, gas
- 9.4 Portable extinguishers
- 9.5 Built-in extinguishing systems: for engines, APU, wheel well, lavatories; storage of extinguishant, discharge of bottles (valve, squibb), directing of extinguisher, blow-out plugs
- 9.6 Properties and effects of extinguishing agents: water, Dry chemical, carbon dioxide, Halon 1301, Halon 1211.
- 9.7 Operation of extinguishing systems
- 9.8 Servicing of extinguishing systems: weight, pressure, temperature compensation

10.0 Ice and Rain Control
- 10.1 Overview: types of ice and icing conditions: rime, clear, frost. Effects of ice on thrust, lift, drag, weight, control, stability. Ice prone areas: leading edges, masts, antennas, inlets, probes, windshields, props.
- 10.2 Types of ice control: ground removal, anti-cing, deicing. Anti-ice/deice systems: thermal, mechanical, chemical.
- 10.3 Thermal deice systems:
  - a. Electrically heated elements: windshields, props, flight controls.
  - b. Components of electric deice systems.
  - c. Inspection and servicing of electric deice systems.
  - d. Hot air deice system.
- 10.4 Mechanical ice removal
  - a. Components and operation: build up and removal of ice, relies on slip stream; upsets airflow over wing, boot inflation.
  - b. Pneumatic deicer inspection, servicing, repair, removal and installation.
- 10.5 Chemical ice removal:
  - a. Types: ground, airborne: windshield, props, leading edge.
  - b. Props: supply, pump, control valve, slinger ring, boots, operational considerations, maintenance.
  - c. Weeping leading edge: supply, pump, medium used, control operation, care and maintenance of components

10.6 Windshield ice/rain control: windshield wipers, pneumatic air blast, rain repellent.
10.7 Miscellaneous deiced components: electric: drain masts, probes, engine inlets, static ports. Hot air: antennas, engine inlets.
10.8 Inertial separators.

11.0 Position and Warning Systems
- 11.1 Overview:
  - a. Caution: alert of abnormal situation.
  - b. Warning: requires immediate attention.
  - c. System annunciations: displays condition or mode of operation.
- 11.2 Types of Warnings:
  - a. Visual: lights, flags, CRT displays
  - b. Aural: bells, clackers, sirens, horns
  - c. Tactile: stick shaker, rudder shaker, stick pusher.
- 11.3 Conditions requiring warnings: fire, overspeed, stall, improper configuration, ground proximity, autopilot disconnect, low cabin pressure.
- 11.4 Conditions requiring cautions; abnormal system conditions: low temperature, high temperature, overspeed, underspeed, low pressure, high pressure, low voltage, high voltage.
- 11.5 Conditions requiring annunciations:
  - a. Mode select: on/off, up/down, auto, manual, standby, hi/lo, etc.
  - b. Built-in monitoring (status flags): power monitor, signal valid/invalid, display valid/invalid, display comparisons
- 11.6 Typical display and annunciation systems: Sensor - communication - decision - display
- 11.7 Typical annunciation and warning systems: landing gear position, autopilot/flight director mode, configuration warning, takeoff, landing, instrument comparator. system annunciations. Master caution system and caution advisory panels.

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 ENVIRONMENTAL CONTROL

Instructional Goal Know the reasons for development and the history of development of auxiliary systems on aircraft.

Defined Outcome The student will describe the development of auxiliary systems for use on aircraft and explain the additional comfort, safety and capabilities they provide.

2.0 CABIN HEAT - EXHAUST HEAT EXCHANGERS

Instructional Goal Know the components required and understand the operation and inspection and servicing requirements for exhaust gas heat exchangers.

Defined Outcome The student will describe component and system operation, and explain procedures for moving, inspecting, reinstalling and testing exhaust gas heating systems.

3.0 CABIN HEAT - COMBUSTION HEATER

Instructional Goal Understand system operation, inspection and servicing requirements.

Defined Outcome Students will describe and explain procedures for operating, inspecting and servicing a combustion heater and isolate the causes of system malfunctions given system components, failure reports and documentation.

4.0 VAPOR CYCLE AIR CONDITIONING

Instructional Goal Understand properties and methods of heat transfer. Understand the changes of state occurring in a vapor cycle. Understand system operation, inspection and servicing requirements.

Defined Outcome Students will describe and explain procedures for operating, inspecting and servicing a vapor cycle air conditioning system and isolate the causes of system malfunctions given system components, failure reports and documentation.

5.0 AIRCYCLE AIR-CONDITIONING

Instructional Goal Understand heat transfer properties and temperature and pressure relationships in gases. Understand air cycle system operation, inspection and servicing requirements.

Defined Outcome Students will describe the cooling and heating airflow paths through an air cycle system and define general temperature and pressure conditions at points in the gas path. The students will describe the purpose and operation of flow control values, temperature sensors and control systems used to operate the system. Given documentation and failure symptoms, students will isolate the most probable causes of system failure.

6.0 PRESSURIZATION SYSTEMS

Instructional Goal Understand the reason for pressurization systems on aircraft, their operation and limitations, the components necessary for proper functioning, servicing and inspection requirements and analysis of failures.

Defined Outcome Students will describe the operation of all components of a pressurization system as well as total system operation. They will recognize components and describe their locations on an aircraft. They will correctly determine the most probable causes of system failure given flight crew write-ups, and system documentation.

7.0 OXYGEN SYSTEMS

Instructional Goal Understand the human requirements for supplemental oxygen at altitude and the effects of a deficiency of oxygen on capabilities. Know the most common methods of providing supplemental oxygen to passengers and flight crews and know the operation, servicing and inspection requirements for those systems.

Defined Outcome The students will describe the requirements for supplemental oxygen from a physiological and regulatory standpoint. They will describe the operation of airborne systems that provide supplemental oxygen, the purpose of each component of those systems and the servicing and inspection requirements of each system. They will analyze irregular operation and determine the most probable causes of system malfunctions.

8.0 FIRE PROTECTION - DETECTION

Instructional Goal Understand the causes of airborne fires and the common means of detecting their occurrence. Know the systems and components required to detect fires and the operation of the warning systems that alert flight crews to the occurance of fires.

Defined Outcome The students will describe causal conditions and locations where fires are likely to occur in aircraft and describe the systems and components that are used to detect their occurrence. Students will explain differences between detection systems along with inspection and servicing requirements for those systems.

9.0 FIRE PROTECTION - EXTINGUISHING

Instructional Goal Know the agents and equipment used to extinguish fires with airborne equipment, their limitations and their design characteristics, inspection and servicing requirements.

Defined Outcome The student will describe the common methods of fire extinguishing, the agent effectiveness and limitations on the different classes of fires. The student will describe the equipment design characteristics, and inspection and servicing requirements.

A T 266 AIRCRAFT AUXILIARY SYSTEMS

10.0 ICE AND RAIN CONTROL

Instructional Goal Know the systems used on aircraft external surfaces to control accumulations of ice or rain that could be detrimental to aircraft operation. Understand system operation, limitations and servicing requirements.

Defined Outcome Students will describe the common methods of ice removal and prevention, the systems and components that accomplish this and the operation, servicing and inspection requirements for those systems.

11.0 POSITION AND WARNING SYSTEMS

Instructional Goal Know those conditions that require cautions, warnings and annunciations to a flight crew and those systems that are used to provide the annunciations or warnings or position indications.

Defined Outcome The student will describe those conditions that require annunciations, warnings or cautions, identify the components of annunciation systems that act as sensors, communicators, decision makers and displays and describe their operation.

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APPROVED
01-04-87 Bettym. Rogers
Date Signature

FAR 147 APPENDIX C (AIRFRAME)

ITEM	LEVEL	
33	1	Repair heating, cooling, air- conditioning, pressurization and oxygen system components.
34	1	Inspect, check, troubleshoot, service and repair heating, airconditioning, cooling and pressurization systems.
35	2	Inspect, check, troubleshoot, service and repair oxygen systems.
49	3	Install, service check airframe electrical wiring, switches, controls, indicators and protective devices.
51	1	Inspect, check and service, speed and takeoff warning systems, electrical brake controls and anti-skid systems.
52	3	Inspect, check, troubleshoot, service, and repair landing gear position indicating and warning systems.
53	2	Inspect, check, troubleshoot, service and repair airframe ice and rain control systems.
54	1	Inspect, check, and service smoke and carbon monoxide detection systems.
55	3	Inspect, check, service, troubleshoot and repair aircraft fire detection and extinguishing systems.

APPENDIX D (POWERPLANT)

ITEM	LEVEL	
11	3	Inspect, check, service, troubleshoot and repair engine fire detection and extinguishing systems.
33	1	Inspect, check, service and repair propeller synchronizing and ice control systems.

A T 266L AIRCRAFT AUXILIARY SYSTEMS LABORATORY

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: This course covers operation, maintenance, servicing, inspection and troubleshooting of auxiliary systems on aircraft. These are systems that are not required to power or control an aircraft in flight but do enhance safety, improve comfort, or extend capabilities of the aircraft. They include environmental control systems (heat, air-conditioning, pressurization, oxygen), ice and rain control systems, fire protection and position indicating and warning systems. Actual aircraft systems or mock-ups are used to provide hands-on training in operation and servicing while troubleshooting exercises are performed either using actual systems or system schematics, wiring diagrams and maintenance information.

b. Credits: Students receive 2 credits for successful completion of this course.

c. Hours: This course is scheduled to meet 4 hours per week for fifteen weeks each semester (3600 min.) in class. In addition (1500 min.) outside work is expected for total student involvement of (5400 min.).

d. The 60 hours of instruction accounts for two holidays and is devoted entirely to laboratory exercises.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab fees: Lab fees for this course are outlined in Appendix A.

g. This course, in conjunction with the AMT curriculum, prepares a student for entry level position in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations in the accompanying lecture class precede preplanned, structured lab exercises that allow students to observe and practice the tasks necessary to build skill and confidence in operation, inspection, servicing and troubleshooting of aircraft auxiliary systems. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

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09-04-87 Bettym Rogers
Date Signature

A T 266L AIRCRAFT AUXILIARY SYSTEMS LABORATORY

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of physics, electricity and aircraft maintenance practices before entering this course. This working knowledge may be demonstrated in the following ways:

a. Passing the following courses, or their equivalent with a grade of C or better:

A T	160	Aircraft Information, Regulations and Procedures
A T	161	Aircraft Assembly
A T	161L	Aircraft Assembly Lab
A T	264	Aircraft Electrical Systems
A T	264L	Aircraft Electrical Systems Lab
PHYS	110	Physics for Technicians

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

c. This course must be taken concurrently with AT 266 Auxiliary Systems lecture course.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods for make-up are listed in Appendix B.

b. Class performance is evaluated by means of written or oral tests and quizzes and class participation.

V. OUTLINE

1.0 Environmental Control Systems - Overview and History of Development
  1.1 Heating: exhaust heat exchangers, combustion heaters, compressors/bleed air.
  1.2 Cooling: vapor cycle air-conditioning, air cycle air-conditioning.
  1.3 Pressurization: FAR's for pressurization and Oxygen, extended capabilities of pressurized aircraft.
  1.4 Oxygen: gaseous HP and LP (High pressure and low pressure), liquid oxygen, chemical generators

2.0 Cabin Heat - Exhaust Heat Exchangers
  2.1 Exhaust gas flow
  2.2 Heated air flow
  2.3 Heat exchanger (baffles, surface area, temperature differential).
  2.4 Heated air control - cabin/carburetor
  2.5 Factors affecting cabin heat (system design, OAT, power setting, airspeed)

2.6 Inspecting and servicing cabin heat systems (heat muff and associated exhaust components inspection, valves and actuating cables, flight dect CO check, cabin heat airworthiness directives).

3.0 Cabin Heat - Combustion Heaters
3.1 Fuel system: supply, valves, press control, pumps, low press and wick, high press and nozzle, safety valve, drain valve.
3.2 Ignition: glow plug, high tension plug and exciter
3.3 Combustion liner: design, materials, integrity checks
3.4 Combustion air flow
3.5 Ventilating air flow
3.6 Operation
3.7 Electrical control and schematics
3.8 Inspection, servicing, airworthiness directives.

4.0 Vapor Cycle Air-Conditioning
4.01 Theory of operation: heat of compression, vaporization, condensation
4.1 Compressor: engine driven, electric motor driven, clutch, RPM range power required, pressure at input and output, lubrication.
4.2 Condenser: location, airflow, refrigerant flow, pressure
4.3 Receiver dryer.
4.4 Expansion valve: oriface, thermostatic control, compensation for evaporator size
4.5 Evaporator: position, design, internal pressure, airflow
4.6 Operation: temperature and pressures in cycle.
4.7 Servicing: evacuating, purging, charging, lubrication, leak check.
4.8 Repairing: water in lines, slugging compressor, slipping belts, clutches, checking and adding lubricant.

5.0 Air Cycle Air-conditioning
5.1 Theory of operation: heat of compression, heat of expansion, heat exchangers, mixing air flows
5.2 Air source: bleed air, turbo-compressor, roots blower
5.3 Filters and shutoff valves (sov): source, cross bleed
5.4 Primary heat exchanger: ambient air flow, cooling air flow, temperature drop.
5.5 Compressor: temperature and pressure changes, power required.
5.6 Secondary heat exchanger: ambient air flow, cooling airflow, temperature drop.
5.7 Turbine: expansion, temperature drop, work extracted.
5.8 Mix valve: motor drive, butterflies
5.9 Water separator: design, servicing
5.10 Temperature controls: cabin sensors, duct sensors, displays, pilot controls

5.11 Temp limit sensors: cold limit (e.g. 35 degree F,) Hot limit, (e.g. 190 degree automatic, 240 degree manual).
5.12 System operation: automatic, manual
5.13 System servicing and troubleshooting

6.0 Pressurization Systems
6.1 Theory of operation: pressure vessel, uncontrolled flow in, controlled flow out.
6.2 Sources of flow: turbocharger, cabin supercharger, turbocompressor, bleed air
6.3 Pressure vessel characteristics: contained volume, minimize leaks, seals for wires, cables, fluid lines, round corners on windows and doors, fatigue checks, pressure limits (e.g. 4.5 to 12 P,S,I,D.)
6.4 Outflow Valve control: pneumatic valve - reference chamber, differential operation, isobaric operation, electrically operated valve: automatic, manual, standby operations. Automatic controls: control of cabin altitude, differential pressure, rate of climb.
6.5 Safety Valves: pressure relief valves, dump valves, negative pressure relief valves.
6.6 Operation, servicing and troubleshooting

7.0 Oxygen Systems
7.1 Oxygen requirements in pressurized and unpressurized aircraft, FAR's 23. 1441, 91.32
7.2 Types of oxygen systems: low press gas, high press gas, liquid oxygen, chemical oxygen generators.
7.3 Gaseous oxygen: bottles: HP., LP., DOT 3AA, DOT 3HT, regulators, relief valves, blow-out plugs, distribution lines, control valves, refilling
7.4 Liquid oxygen: storage container, evaporator, controls, refilling, distribution
7.5 Chemical oxygen generators: chemical reaction, oxygen output, by-products, starting reaction, distribution of oxygen, heat generated, servicing
7.6 Operation servicing and troubleshooting of oxygen systems: leak detection, cleaning lines, replacing seals or connections, hydrostatic checking of cylinders.
7.7 Portable oxygen systems
7.8 Breathing apparatus: oriface with rebreather bag, diluter/demand masks, pressure demand mask and control.

8.0 Fire Protection - Detection
8.1 Fire zones: FAR 25.1181 engine, APU, accessory area, cargo, lavatory, wheelwell, combustion heaters, passenger/crew areas
8.2 Spot detectors: thermoswitch operation, positioning, wiring, warnings (aural, visual) limitations, maintenance, testing

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8.3 Thermocouple: thermocouple operation, positioning, wiring absolute temperature vs. rate of rise, limitations, testing, servicing

8.4 Continuous loop systems: single wire thermistor, twin wire eutectic salt, gas pressure systems. Construction, connections, installation, testing, servicing, repairing, warnings, operation

8.5 Smoke detectors: photo, optical, ionization. Operation, testing, servicing.

9.0 Fire Protection - Extinguishing

9.1 Theory: cool, remove combustible material, remove oxygen interference with combustion process (i.e. halon).

9.2 Classes of fire: A,B,C

9.3 Types of extinguishers: Liquid (water), dry chem, gas

9.4 Portable extinguishers

9.5 Built-in extinguishing systems: for engines, APU, wheel well, lavatories; storage of extinguishant, discharge of bottles (valve, squibb), directing of extinguisher, blow-out plugs

9.6 Properties and effects of extinguishing agents: water, Dry chemical, carbon dioxide, Halon 1301, Halon 1211.

9.7 Operation of extinguishing systems

9.8 Servicing of extinguishing systems: weight, pressure, temperature compensation

10.0 Ice and Rain Control

10.1 Overview: types of ice and icing conditions: rime, clear, frost. Effects of ice on thrust, lift, drag, weight, control, stability. Ice prone areas: leading edges, masts, antennas, inlets, probes, windshields, props.

10.2 Types of ice control: ground removal, anti-cing, deicing. Antiice/deice systems: thermal, mechanical, chemical.

10.3 Thermal deice systems:

a. Electrically heated elements: windshields, props, flight controls.

b. Components of electric deice systems.

c. Inspection and servicing of electric deice systems.

d. Hot air deice system.

10.4 Mechanical ice removal

a. Components and operation: build up and removal of ice, relies on slip stream; upsets airflow over wing, boot inflation.

b. Pneumatic deicer inspection, servicing, repair, removal and installation.

- 10.5 Chemical Ice Removal:
  - a. Types: ground, airborne: windshield, props, leading edge.
  - b. Props: supply, pump, control valve, slinger ring, boots, operational considerations, maintenance.
  - c. Weeping leading edge: supply, pump, medium used, control operation, care and maintenance of components
- 10.6 Windshield ice/rain control: windshield wipers, pneumatic air blast, rain repellent.
- 10.7 Miscellaneous deiced components: electric: drain masts, probes, engine inlets, static ports. Hot air: antennas, engine inlets.
- 10.8 Inertial separators.

11.0 Position and Warning Systems

- 11.1 Overview:
  - a. Caution: alert of abnormal situation.
  - b. Warning: requires immediate attention.
  - c. System annunciations: displays condition or mode of operation.
- 11.2 Types of warnings:
  Visual: lights, flags, CRT, display
  Aural: bells, clackers, sirens, horns
  Tactile: stick shaker, rudder shaker, stick pusher.
- 11.3 Conditions requiring warnings: fire, overspeed, stall, improper configuration, ground proximity, autopilot disconnect, low cabin pressure.
- 11.4 Conditions requiring cautions; abnormal system conditions: low temperature, high temperature, overspeed, underspeed, low pressure, high pressure, low voltage, high voltage.
- 11.5 Conditions requiring annunciations:
  - a. Mode select: on/off, up/down, auto, manual, standby, hi/lo, etc.
  - b. Built-in monitoring (status flags): power monitor, signal - valid/invalid, display valid/invalid, display comparisons
- 11.6 Typical display and annunciation systems:
  sensor - communication - decision - display
- 11.7 Typical annunciation and warning systems: landing gear position, autopilot/flight director mode, configuration warning, takeoff, landing, instrument comparator. system annunciations. Master caution system and caution advisory panels.

A T 266L AIRCRAFT AUXILIARY SYSTEMS LABORATORY

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 ENVIRONMENTAL CONTROL

Instructional Goal Know the reasons for development and the history of development of auxiliary systems on aircraft.

Defined Outcome The student will describe the development of auxiliary systems for use on aircraft and explain the additional comfort, safety and capabilities they provide.

2.0 CABIN HEAT - EXHAUST HEAT EXCHANGERS

Instructional Goal Know the components required and understand the operation and inspection and servicing requirements for exhaust gas heat exchangers.

Defined Outcome The student will describe component and system operation, and remove, inspect, reinstall and test exhaust gas heating systems.

3.0 CABIN HEAT - COMBUSTION HEATER

Instructional Goal Understand system operation, inspection and servicing requirements.

Defined Outcome Students will operate, inspect and service a combustion heater and isolate the causes of system malfunctions given system components and or documentation.

4.0 VAPOR CYCLE AIR CONDITIONING

Instructional Goal Understand properties and methods of heat transfer. Understand the changes of state occurring in a vapor cycle. Understand system operation, inspection and servicing requirements.

Defined Outcome Students will operate, inspect and service a vapor cycle air conditioning system and isolate the causes of system malfunctions given system components and documentation.

5.0 AIR CYCLE AIR-CONDITIONING

Instructional Goal Understand heat transfer properties and temperature and pressure relationships in gases. Understand air cycle system operation, inspection and servicing requirements.

Defined Outcome Students will describe the cooling and heating airflow paths through an air cycle system and define general temperature and pressure conditions at points in the gas path. The students will describe the purpose and operation of flow control values, temperature sensors and control systems used to operate the system. Given documentation and failure symptoms, students will isolate the most probable causes of system failure.

6.0 PRESSURIZATION SYSTEMS

Instructional Goal Understand the reason for pressurization systems on aircraft, their operation and limitations, the components necessary for proper functioning, servicing and inspection requirements and analysis of failures.

Defined Outcome Students will describe the operation of all components of a pressurization system as well as total system operation. They will recognize components and describe their locations on an aircraft. They will correctly determine the most probable causes of system failure given flight crew write-ups, and system documentation.

7.0 OXYGEN SYSTEMS

Instructional Goal Understand the human requirements for supplemental oxygen at altitude and the effects of a deficiency of oxygen on capabilities. Know the most common methods of providing supplemental oxygen to passengers and flight crews and know the operation, servicing and inspection requirements for those systems.

Defined Outcome The students will describe the requirements for supplemental oxygen from a physiological and regulatory standpoint. They will describe the operation of airborne systems that provide supplemental oxygen, the purpose of each component of those systems and the servicing and inspection requirements of each system. They will analyze irregular operation and determine the most probable causes of system malfunctions.

8.0 FIRE PROTECTION - DETECTION

Instructional Goal Understand the causes of airborne fires and the common means of detecting their occurrence. Know the systems and components required to detect fires and the operation of the warning systems that alert flight crews to the occurrence of fires.

Defined Outcome The students will describe causal conditions and locations where fires are likely to occur in aircraft and describe the systems and components that are used to detect their occurrence. Students will explain differences between detection systems, along with inspection and servicing requirements for those systems. Given the proper components and requirements the students will design and build a fire detection system and troubleshoot its malfunctions.

9.0 FIRE PROTECTION - EXTINGUISHING

Instructional Goal Know the agents and equipment used to extinguish fires with airborne equipment, their limitations and their design characteristics, inspection and servicing requirements.

Defined Outcome The student will describe the common methods of fire extinguishing, the agents effectiveness and limitations on the different classes of fires. The student will describe the equipment design characteristics, inspection and servicing requirements.

10.0 ICE AND RAIN CONTROL

Instructional Goal Know the systems used on aircraft external surfaces to control accumulations of ice or rain that could be detrimental to aircraft operation. Understand system operation, limitations and servicing requirements.

Defined Outcome Students will describe the common methods of ice removal and prevention, the systems and components that accomplish this and the operation, servicing and inspection requirements for those systems.

11.0 POSITION AND WARNING SYSTEMS

Instructional Goal Know those conditions that require cautions, warnings and annunciations to a flight crew and those systems that are used to provide the annunciations or warnings or position indications.

Defined Outcome The student will describe those conditions that require annunciations, warnings or cautions, identify the components of annunciation systems that act as sensors, communicators, decision makers and displays and describe their operation. Given the proper components and requirements the students will design, operate and troubleshoot a position indication or warning system.

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VII. PROJECTS

FAA Level

1 1.0 Overview of Environmental Control Systems
Projects as available and applicable.

3 2.0 Cabin Heat - Exhaust Heat Exchangers
Completely disassemble, inspect, pressure check, reassemble and operate an exhaust heat exchanger and all associated exhaust components and record all pertinent information in inspection record and aircraft logbooks.

2 3.0 Cabin Heat - Combustion Heaters
Disassemble, inspect, pressure decay test, reassemble and operate a combustion heater and record all pertinent operational, inspection and discrepancy information in the appropriate records.

2 4.0 Vapor Cycle Air-Conditioning
Depressurize, evacuate, purge, refill leak check and operationally check a vapor cycle air-conditioning system. Record all pertinent inspection and operational information in the appropriate records.

1 5.0 Air Cycle Air-Conditioning
Research assigned aircraft with air cycle system and prepare a diagram showing airflow, control valves, heat exchangers, turbine, compressor, temperature sensors and other operational hardware. Identify servicing requirements for lubrication, filters, water separator etc. Given a set of schematics and abnormal indications identify the probable malfunction in automatic and manual temperature control systems.

1 6.0 Pressurization Systems
Field trip to pressurized aircraft
Projects as available and applicable.

2 7.0 Oxygen Systems
Research and report on oxygen system installation, components operation and servicing for assigned aircraft. Service a high or low pressure gaseous oxygen system in aircraft or mock-up assuring compliance with manufacturers' and Department of Transportation regulations.

3 8.0 Fire Detection
Given the required components and operational information, Design, wire and test a thermoswitch type fire detection system whose operation parallels that of an actual aircraft system.

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Level

9.0 Fire Extinguishing

3 Determine state of charge of (extinguishers containers) by weight and pressure method. Determine causes of extinguisher discharge by observation of blow-out plugs. Perform continuity check of discharge cartridge.

10.0 Ice and Rain Control

2 Install deice boot on leading edge of wing control surface or propeller. Inspect and troubleshoot electric prop deice system. Record all pertinent information in appropriate logbooks.

11.0 Position and Warning System

3 Given system requirements and the proper components design, build and test a landing gear position indicating system whose operation parallels that of an assigned aircraft.

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FAR 147 Appendix B (Gen)

Item	Level	
28	3	Write descriptions of aircraft condition and work performed.
29	3	Complete required maintenance forms, records, and inspection reports.
31	3	Select and use FAA and manufacturers' aircraft maintenance specifications, data sheets, manuals, and publications, and related Federal Aviation Regulations.
32	3	Read Technical Data.

Appendix C (Airframe)

24	2	Check Alignment of Structures.
28	3	Perform airframe conformity and airworthiness inspections.

Appendix D (powerplant)

8	3	Perform powerplant conformity and airworthiness inspections.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: This course provides in-depth coverage of scheduled and non-scheduled aircraft inspections. Information is provided on the regulations governing inspections, the data necessary to perform inspections, inspection techniques, and the forms and records necessary to record the occurrence and findings of inspections. Students participate in planning, researching data and performing complete aircraft inspections (annual and 100 hr) as well as less detailed scheduled and non-scheduled inspections. Classroom troubleshooting is performed by isolating probable faults in aircraft systems based on flight crew failure reports. Troubleshooting procedures and system operations information is obtained from appropriate manufacturers' manuals, wiring diagrams and schematics.

b. Credits: Students receive 3 credits for successful completion of this course.

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c. Hours: The class is scheduled to meet 4 hours per week for fifteen weeks each semester (3600 min.) in class. In addition (4500 min.) outside work is expected for (8100 min.) total student involvement.

d. The 58 hours of instruction accounts for two holidays and is devoted entirely to formal classroom presentations.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab Fees: No lab fees

g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations precede preplanned, structured lab exercises that allow the students to observe and practice the tasks necessary to build skill and confidence in performing aircraft inspections and fault isolation. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of math, physics, aviation publications, and aircraft hardware before entering this course. This working knowledge may be demonstrated in the following ways:

a. Passing the following courses with a grade of C or better.

A T 163	Aircraft Electrical Components
A T 163L	Aircraft Electrical Components Lab.
A T 260	Aircraft Reciprocating Engines
A T 260L	Aircraft Reciprocating Engines Lab
A T 262	Aircraft Turbine Engines
A T 262L	Aircraft Turbine Engines Lab
A T 263	Aircraft Fluid Power Systems
A T 263L	Aircraft Fluid Power Systems Lab

This course must be preceded by or taken concurrently with AT 264, Aircraft Electrical Systems and AT 264L.

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

c. This course must be taken concurrently with AT 267L.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods of makeup are outlined in Appendix B.

b. Class performance will be evaluated by written or oral quizzes or tests and class participation.

c. Final grades for students are computed by averaging grades from tests, homework, reports and class participation.

V. COURSE OUTLINE

1.0 Inspection Basics: Definitions and Examples
- 1.1 Scheduled inspections: preflight, daily, annual, 100 hour, periodic, progressive, phased., hot section inspection.
- 1.2 Non-scheduled Inspections: hard landing, prop strike, rapid depressurization, severe turbulence, high energy stop, overpressurization, lightning strike, bird strike, overspeed, extreme dust, ice or snow, airworthiness directive required inspection.
- 1.3 Other inspections: Byers, damage assessment, post storage.

2.0 Regulations Governing Inspection
- 2.1 FAR 91, what inspections must be performed (private).
- 2.2 FAR 135 & 121, what inspections must be performed (commercial).
- 2.3 FAR 43, performance standards for inspections.
- 2.4 FAR 65, persons authorized to perform inspections.
- 2.5 FAR 145,inspections by certified repair stations.

3.0 Use of Necessary Data for Inspections
- 3.1 FAA specifications and type certificates.
- 3.2 Manufacturers' maintenance manual and inspection sheet
- 3.3 Illustrated parts catalog
- 3.4 Service information (airframe, engine, components)
- 3.5 Airworthiness directives
- 3.6 Operators' manuals
- 3.7 Airworthiness alerts and SDR's (service difficulty reports)

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4.0 Forms and Records
  4.1 Equipment list
  4.2 Airworthiness directive requirements
  4.3 Airframe and engine maintenance records
  4.4 Discrepancy list
  4.5 Labor and parts record
  4.6 Form 337
  4.7 Tracking time/ life limited parts

5.0 Inspection Techniques
  5.1 Shop technique and mechanic edignite
  5.2 Access and cleanliness
  5.3 Visual inspections
  5.4 NDT inspections
  5.5 Operational inspections
  5.6 Special test equipment

6.0 Reporting Inspection Results
  6.1 Maintenance record entries
  6.2 Malfunction or defect reports

7.0 Reciprocating Engine Troubleshooting
  7.1 Fuel system
  7.2 Ignition system
  7.3 Electrical system (starter, generator, regulator)
  7.4 Engine indicating systems
  7.5 Engine internal
  7.6 Propeller track, balance, vibrating control

8.0 Turbine Engine Troubleshooting
  8.1 Fuel system (pumps, nozzles, distribution)
  8.2 Ignition system
  8.3 Electrical system (starter, generator, regulator)
  8.4 Engine indicating systems
  8.5 Engine internal
  8.6 Propeller and rotor systems

9.0 Airframe Systems Troubleshooting
  9.1 Electrical distribution
  9.2 Lighting
  9.3 Position and warning systems (indicators, annuniciators)
  9.4 Hydraulic systems
  9.5 Flight controls
  9.6 Other auxiliary systems

10.0 Mechanic Certification and Employment
  10.1 Time requirements
  10.2 Written testing requirements

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10.3 Oral and practical testing requirements
10.4 Employment relationships
  a. Job seeking
  b. Employee responsibilities
  c. Lines of authority
  d. Regulatory action and appeals

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 INSPECTION BASICS

Instructional Goal: Know the types of scheduled and non-scheduled inspections performed regularly on aircraft or airborne systems, their value to safe operations and the general factors affecting airworthiness of systems and components inspected.

Defined Outcome: The student will determine the type of inspection to be performed on given aircraft, system or component under given circumstances, accurately describe the findings of that inspection, and correctly determine the airworthiness of the item inspected based on those findings.

2.0 REGULATIONS GOVERNING INSPECTIONS

Instructional Goal: Know what Federal Aviation Regulations (FAR's) apply to the performance of inspections, inspection authority of individuals, requency of inspections and inspections standards.

Defined Outcome: The student will find and quote the proper title, part, section and paragraph of the FAR's that provides an authoritative answer to questions posed about inspections.

3.0 DATA FOR INSPECTION

Instructional Goal: Know the existence, organization and use of government and manufacturer publications that establish inspection criteria.

Defined Outcome: Given access to necessary publications a student will choose the correct manuals and reference all the proper criteria in preparing to perform inspections on aircraft, their systems and components.

4.0 FORMS AND RECORDS

Instructional Goal: Know use of forms and records designed to track aircraft and components' inspection status, time, cycles and airworthiness. Know the required and recommended records and recordkeeping processes.

A T 267 AIRCRAFT INSPECTION AND TROUBLESHOOTING

Defined Outcome: For a given aircraft the student will compile an equipment list, list of alterations, and airworthiness directive listing. The student will also record components and systems inspected and their status, discrepancies found, repairs made, parts used (by manufacturer and part number), time spent on inspection and repairs, and a record of major repairs or alterations on the FAA prescribed Form 337.

5.0 INSPECTION TECHNIQUES

Instructional Goal: Know the proper techniques for inspection of aircraft structure and systems to include but not restricted to: disassembly, cleaning, visual inspection, non-destructive testing, operational tests and use of special test equipment.

Defined Outcomes: The student will properly perform required inspections on assigned aircraft, their systems and components. All discrepancies will be identified regardless of their effect on airworthiness and the aircraft will be returned to its original (preinspection) condition.

6.0 REPORTING INSPECTION RESULTS

Instructional Goal: Know procedures for recording inspection results. Know advantages of sharing inspection findings through malfunction or defect reports, airworthiness alerts and service difficulty reports.

Defined Outcomes: The student will list inspection results including all discrepancies and the status (airworthy or unairworthy) of the aircraft, systems or components inspected. All findings of potential interest to other operators will be submitted to the FAA on Form 8010-4.

7.0 RECIPROCATING ENGINE TROUBLESHOOTING

Instructional Goal: Know proper operation of airframe and powerplant systems and subsystems, determine existence of malfunctions in those systems, isolate to the component level the cause of each malfunction, and recommend or perform corrective action.

Defined Outcome: Given an aircraft or simulated aircraft system the student will determine if it is operating properly, and if a malfunction exists the student will isolate the cause of that malfunction and initiate corrective action.

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8.0 TURBINE ENGINE TROUBLESHOOTING

Instructional Goal: Know proper operation of airframe and powerplant systems and subsystems, determine existence of malfunctions in those systems, isolate to the component level the cause of each malfunction, and recommend or perform corrective action.

Defined Outcome: Given an aircraft or simulated aircraft system the student will determine if it is operating properly, and if a malfunction exists the student will isolate the cause of that malfunction and initiate corrective action.

9.0 AIRFRAME SYSTEMS TROUBLESHOOTING

Instructional Goal: Know proper operation of airframe and powerplant systems and subsystems, determine existence of malfunctions in those systems, isolate to the component level the cause of each malfunction, and recommend or perform corrective action.

Defined Outcome: Given an aircraft or simulated aircraft system the student will determine if it is operating properly, and if a malfunction exists the student will isolate the cause of that malfunction and initiate corrective action.

10.0 MECHANIC CERTIFICATION AND EMPLOYMENT

Instructional Goal Know the testing and cetification procedures required to obtain the FAA mechanic's certificate with an airframe or powerplant rating.

Defined Outcome The student will describe the steps necessary to obtain a mechanic's certificate from the FAA, the time limits involved and the options available.

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FAR 147 Appendix B (Gen)

Item	Level	
28	3	Write descriptions of aircraft condition and work performed.
29	3	Complete required maintenance forms, records, and inspection reports.
31	3	Select and use FAA and manufacturers' aircraft maintenance specifications, data sheets, manuals, and publications, and related Federal Aviation Regulations.
32	3	Read Technical Data.

Appendix C (Airframe)

Item	Level	
24	2	Check Alignment of Structures.
28	3	Perform airframe conformity and airworthiness inspections.

Appendix D (powerplant)

Item	Level	
8	3	Perform powerplant conformity and airworthiness inspections.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: This course provides in-depth coverage of scheduled and non-scheduled aircraft inspections. Information is provided on the regulations governing inspections, the data necessary to perform inspections, inspection techniques, and the forms and records necessary to record the occurrence and findings of inspections. Students participate in planning, researching data and performing complete aircraft inspections (annual and 100 hr) as well as less detailed scheduled and non-scheduled inspections. Classroom troubleshooting is performed by isolating probable faults in aircraft systems based on flight crew failure reports. Troubleshooting procedures and system operations information is obtained from appropriate manufacturers' manuals, wiring diagrams and schematics.

b. Credits: Students receive 2 credits for successful completion of this course.

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c. Hours: The class is scheduled to meet 6 hours per week for fifteen weeks each semester (5400 min.) in class. In addition (1800 min.) outside work is expected for (7200 min.) total student involvement.

d. The 87 hours of instruction accounts for two holidays and is devoted entirely to lab exercises.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

f. Lab Fees: Lab fees for this course are outlined in appendix A.

g. This course, in conjunction with the AMT curriculum, prepares an individual for entry level positions in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations in the accompanying lecture class precede preplanned, structured lab exercises that allow the students to observe and practice the tasks necessary to build skill, and self-confidence in performing aircraft inspections and fault isolation. Students isolate system faults on actual aircraft and powerplants and on simulated aircraft systems, using flight crew reports, manufacturers' manuals, and test equipment to determine failure causes and recommend corrective action. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of math, physics, aviation publications, and aircraft hardware before entering this course. This working knowledge may be demonstrated in the following ways:

a. Passing the following courses with a grade of C or better.

A T 163	Aircraft Electrical Components
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A T 260	Aircraft Reciprocating Engines
A T 260L	Aircraft Reciprocating Engines Lab
A T 262	Aircraft Turbine Engines
A T 262L	Aircraft Turbine Engines Lab
A T 263	Aircraft Fluid Power Systems
A T 263L	Aircraft Fluid Power Systems Lab

This course must be preceded by or taken concurrently with AT 264, Aircraft Electrical Systems and AT 264L.

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

c. This course must be taken concurrently with AT 267.

IV. EVALUATION

a. Class attendance is mandatory. Effects of student absences and methods of makeup are outlined in Appendix B.

b. Class performance will be evaluated by written or oral quizzes or tests and class participation.

c. Final grades for students are computed by averaging grades from tests, homework, reports and class participation.

V. COURSE OUTLINE

1.0 Inspection Basics: Definitions and Examples
  1.1 Scheduled Inspections: preflight, daily, annual, 100 hour, periodic, progressive, phased., hot section inspection.
  1.2 Non-scheduled Inspections: hard landing, prop strike, rapid depressurization, severe turbulence, high energy stop, overpressurization, lightning strike, bird strike, overspeed, extreme dust, ice or snow, airworthiness directive required inspection.
  1.3 Other inspections: Byers, damage assessment, post storage.

2.0 Regulations Governing Inspection
  2.1 FAR 91, what inspections must be performed (private).
  2.2 FAR 135 & 121, what inspections must be performed (commercial).
  2.3 FAR 43, performance standards for inspections.
  2.4 FAR 65, persons authorized to perform inspections.
  2.5 FAR 145, inspections by certified repair stations.

3.0 Use of Necessary Data for Inspections
  3.1 FAA specifications and type certificates.
  3.2 Manufacturers' maintenance manual and inspection sheet
  3.3 Illustrated parts catalog
  3.4 Service information (airframe, engine, components)
  3.5 Airworthiness directives
  3.6 Operators' manuals
  3.7 Airworthiness alerts and SDR's (service difficulty reports).

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A T 267L AIRCRAFT INSPECTIONS AND TROUBLESHOOTING LABORATORY

4.0 Forms and Records
    4.1 Equipment list
    4.2 Airworthiness directive requirements
    4.3 Airframe and engine maintenance records
    4.4 Discrepancy List
    4.5 Labor and Parts Record
    4.6 Form 337
    4.7 Tracking time/ life limited parts

5.0 Inspection Techniques
    5.1 Shop technique and mechanic edignite
    5.2 Access and cleanliness
    5.3 Visual inspections
    5.4 NDT inspections
    5.5 Operational inspections
    5.6 Special test equipment

6.0 Reporting Inspection Results
    6.1 Maintenance record entries
    6.2 Malfunction or defect reports

7.0 Reciprocating Engine Troubleshooting
    7.1 Fuel system
    7.2 Ignition system
    7.3 Electrical system (starter, generator, regulator)
    7.4 Engine indicating systems
    7.5 Engine internal
    7.6 Propeller track, balance, vibrating control

8.0 Turbine engine Troubleshooting
    8.1 Fuel system (pumps, nozzles, distribution)
    8.2 Ignition System
    8.3 Electrical system (starter, generator, regulator)
    8.4 Engine indicating systems
    8.5 Engine internal
    8.6 Propeller and rotor systems

9.0 Airframe Systems Troubleshooting
    9.1 Electrical distribution
    9.2 Lighting
    9.3 Position and warning systems (indicators, annuniciators)
    9.4 Hydraulic systems
    9.5 Flight controls
    9.6 Other auxiliary systems

10.0 Mechanic Certification and Employment
    10.1 Time requirements
    10.2 Written testing requirements

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10.3 Oral and practical testing requirements
10.4 Employment relationships
  a. Job seeking
  b. Employee responsibilities
  c. Lines of authority
  d. Regulatory action and appeals

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 INSPECTION BASICS

Instructional Goal: Know the types of scheduled and non-scheduled inspections performed regularly on aircraft or airborne systems, their value to safe operations and the general factors affecting airworthiness of systems and components inspected.

Defined Outcome: The student will determine the type of inspection to be performed on given aircraft, system or component under given circumstances, accurately describe the findings of that inspection, and correctly determine the airworthiness of the item inspected based on those findings.

2.0 REGULATIONS GOVERNING INSPECTIONS

Instructional Goal: Know what Federal Aviation Regulations (FAR's) apply to the performance of inspections, inspection authority of individuals, frequency of inspections and inspections standards.

Defined Outcome: The student will find and quote the proper title, part, section and paragraph of the FAR's that provides an authoritative answer to questions posed about inspections.

3.0 DATA FOR INSPECTION

Instructional Goal: Know the existence, organization and use of government and manufacturer publications that establish inspection criteria.

Defined Outcome: Given access to necessary publications a student will choose the correct manuals and reference all the proper criteria in preparing to perform inspections on aircraft, their systems and components.

4.0 FORMS AND RECORDS

Instructional Goal: Know use of forms and records designed to track aircraft and components' inspection status, time, cycles and airworthiness. Know the required and recommended records and record-keeping processes.

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Defined Outcome: For a given aircraft the student will compile an equipment list, list of alterations, and Airworthiness Directive listing. The student will also record components and systems inspected and their status, discrepancies found, repairs made, parts used (by manufacturer and part number), time spent on inspection and repairs, and a record of major repairs or alterations on the FAA prescribed Form 337.

5.0 INSPECTION TECHNIQUES

Instructional Goal: Know the proper techniques for inspection of aircraft structure and systems to include but not restricted to: disassembly, cleaning, visual inspection, non-destructive testing, operational tests and use of special test equipment.

Defined Outcomes: The student will properly perform required inspections on assigned aircraft, their systems and components. All discrepanies will be identified regardless of their effect on airworthiness and the aircraft will be returned to its original (preinspection) condition.

6.0 REPORTING INSPECTION RESULTS

Instructional Goal: Know procedures for recording inspection results. Know advantages of sharing inspection findings through malfunction or defect reports, airworthiness alerts and service difficulty reports.

Defined Outcomes: The student will list inspection results including all discrepancies and the status (airworthy or unairworthy) of the aircraft, systems or components inspected. All findings of potential interest to other operators will be submitted to the FAA on Form 8010-4.

7.0 RECIPROCATING ENGINE TROUBLESHOOTING

Instructional Goal: Know proper operation of airframe and powerplant systems and subsystems, determine existence of malfunctions in those systems, isolate to the component level the cause of each malfunction, and recommend or perform corrective action.

Defined Outcome: Given an aircraft or simulated aircraft system the student will determine if it is operating properly, and if a malfunction exists the student will isolate the cause of that malfunction and initiate corrective action.

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8.0 TURBINE ENGINE TROUBLESHOOTING

Instructional Goal: Know proper operation of airframe and powerplant systems and subsystems, determine existence of malfunctions in those systems, isolate to the component level the cause of each malfunction, and recommend or perform corrective action.

Defined Outcome: Given an aircraft or simulated aircraft system the student will determine if it is operating properly, and if a malfunction exists the student will isolate the cause of that malfunction and initiate corrective action.

9.0 AIRFRAME SYSTEMS TROUBLESHOOTING

Instructional Goal: Know proper operation of airframe and powerplant systems and subsystems, determine existence of malfunctions in those systems, isolate to the component level the cause of each malfunction, and recommend or perform corrective action.

Defined Outcome: Given an aircraft or simulated aircraft system the student will determine if it is operating properly, and if a malfunction exists the student will isolate the cause of that malfunction and initiate corrective action.

10.0 MECHANIC CERTIFICATION AND EMPLOYMENT

Instructional Goal Know the testing and certification procedures required to obtain the FAA Mechanic's certificate with an airframe and powerplant rating.

Defined Outcome The student will describe the steps necessary to obtain a mechanic's certificate from the FAA, the time limits involved and the options available.

VII. OUTLINE - PROJECTS

FAA Level	
3	1.0 Inspection Basics: Research required material.
3	2.0 Regulations Governing Inspections Research required material.
3	3.0 Data for Inspections Research required material.

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FAA Level

4.0 Aircraft Records

3 4.1 Use type certificate data sheets to determine if a given aircraft, engine or propeller conforms to its certified condition. Insure presence of all required equipment and note any alterations that exist.

4.2 Complete a detailed equipment list for a given aircraft. Include make, model, part number and serial number for engine, propeller aircraft, engine accessories e.g. magnetos, carburetors, starter, generator, regulator, vacuum pump, air filter, turbo, propeller governor, etc., radios, instruments and equipment. Also include date and aircraft time of installation and recommended time between overhauls (TBO's) for each component.

4.3 Research airworthiness directives (AD's) and list those that may apply to given aircraft, engine, or prop, equipment, radios, instruments or general components. Use aircraft records and actual aircraft and components to determine applicability and compliance with AD's.

5.0 Inspections

3 5.1 Complete preflight inspection of a given aircraft in accordance with manufacturers' recommendations. Start and taxi aircraft and perform complete run-up, noting all pertinent engine operational parameters including: static RPM, idle RPM, mag drop, oil pressure, oil temperature, fuel flow, manifold pressure, electric system indications, idle mixture indications, tach accuracy, CHT, EGT at various power settings, gyro and flight instrument operation.

5.2 Clean aircraft and remove access panels in preparation for a complete aircraft inspection (100 hour or annual).

5.3 Perform designated portions of a complete aircraft inspection on aircraft, engine and components keeping a record of inspected items on an inspection checklist and inspection results on a discrepancy sheet.

6.0 Reporting of Inspection Results

3 6.1 Students will compile completed records of inspections performed and the results of those inspections to reflect complete aircraft condition.

7.0 Reciprocating Engine Troubleshooting

2 7.1 Determine the cause of faults in the ignition systems such as: broken P-lead, shorted high tension lead, arcing outlet block, burned points, improper mag to engine timing, improper firing sequence, improper internal mag timing.

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FAA Level

7.2 Determine the cause of faults in the fuel system such as: sunken carb float, restricted fuel line, blocked carb bowl vent, plugged carb oriface, leaking induction gasket, improper mixture control, improper throttle control, blocked screen, leaking or blocked selector valve, water contamination, leaking primer.

7.3 Determine the cause of faults in the engine electrical power system such as: shorted field, grounded field, open field, open master solenoid, open starter solenoid, worn brushes, open regulator, shorted regulator, belt slipping.

7.4 Determine the cause of faults in the engine indicating instrument systems such as: tachometer, fuel flow, oil temperature oil pressure, manifold pressure, CHT, EGT, carburetor air temperature, fuel quantity.

7.5 Determine the cause of propeller vibration or pitch control faults.

8.0 Turbine Engine Troubleshooting

8.1 Determine the cause of failures in the ignition system.

2 8.2 Determine the cause of failures in the fuel system.

8.3 Determine the cause of failures in the electrical power system.

8.4 Determine the cause of failures in the engine indicating system.

9.0 Airframe Systems Troubleshooting: Determine the cause of failure and isolate the faulty component in the following types of systems. 2

9.1 Electrical distribution
9.2 Lighting
9.3 Position and warning systems
9.4 Hydraulics systems
9.5 Flight controls
9.6 Auxiliary systems

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FAR 147 APPENDIX B (GENERAL)

ITEM	LEVEL	
18	3	Inspect and check welds.

APPENDIX C (AIRFRAME)

ITEM	LEVEL	
4	1	Select and apply fabric and fiberglass covering materials.
5	3	Inspect, test, and repair fabric and fiberglass.
6	1	Apply trim letters and touchup paint.
7	2	Identify and select aircraft finishing materials.
8	2	Apply paint and dope.
9	2	Inspect finishes and identify defects.
17	1	Weld magnesium and titanium.
18	1	Solder stainless steel.
19	1	Fabricate tubular structures.
20	2	Solder, braze, gas weld and arc weld steel.
21	2	Weld aluminum and stainless steel.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Beginning with historical background, the student will be exposed to the theory of and techniques used in the tubular steel structures, aircraft dope and fabric procedures and paint systems.

b. Credits: Students will receive 1 credit for successful completion of this course.

c. Hours: This course is scheduled to meet 2 hours per week for fifteen weeks each semester (1800 min.) in class. In addition (1800 min.) of outside work is expected for total student involvement of (3600 min.).

d. The 29 hours of instruction accounts for two holidays and is devoted entirely to classroom presentations.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

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f. Lab fees: No lab fees.

g. This course, in conjunction with the AMT curriculum prepares an individual for entry level positions in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations will precede preplanned, structured lab exercises that are presented in the accompanying laboratory courses and allow the students to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance functions on traditional aircraft structures. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

Students must have a working knowledge of aviation publications, and aircraft materials and processes before entering this course. This working knowledge may be demonstrated in the following ways:

a. Passing the following courses or their equivalent with a grade of "C" or better:

A T 160 Aircraft Information, Regulations and Procedures

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

c. This course must be taken concurrently with AT 268L Fundamentals of Aircraft Welding, Covering and Finishing.

IV. EVALUATION

a. Class attendance is mandatory. Effects of absences and methods for makeup are outlined in Appendix B.

b. Class performance will be evaluated by written or oral examinations.

V. COURSE OUTLINE

0.0 Safety procedures for metal working and torch usage

1.0 Welding
  1.1 General terminology
  1.2 Types of welding processes
  1.3 Safety procedures

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A T 268 FUNDAMENTALS OF AIRCRAFT WELDING, COVERING AND FINISHING

- 1.4 Equipment and facilities
- 1.5 Materials required

2.0 Oxygen-Acetylene Welding without Filler Rod
- 2.1 Procedure use of equipment
- 2.2 Safety precautions
- 2.3 Welding basics
- 2.4 Temperatures of molten metal
- 2.5 Puddle formation and penetration

3.0 Oxygen-Acetylene Welding with Filler Rod
- 3.1 Welding procedures
- 3.2 Weld bead formation and penetration and inspection.
- 3.3 Determining airworthiness welds
- 3.4 Inside sleeve splice
- 3.5 Fabrication procedures for cluster welding

4.0 Oxygen-Acetylene Cutting
- 4.1 Equipment and safety precautions
- 4.2 Torch cutting use
- 4.3 Metal cutting procedure
- 4.4 Plate cutting

5.0 Brazing
- 5.1 Equipment and components
- 5.2 Procedures and applications
- 5.3 Puddle manipulation
- 5.4 Determining airworthiness

6.0 Other Welding Processes
- 6.1 ARC
- 6.2 Shielded ARC
- 6.3 Soldering
- 6.4 Magnesium, aluminum, stainless steel

7.0 Aircraft Fabrics
- 7.1 Terminology
- 7.2 Quality and strength requirements
- 7.3 Natural fiber
- 7.4 Synthetic
- 7.5 Testing

8.0 Miscellaneous Fabric Materials
- 8.1 Reinforcing tape
- 8.2 Sewing thread
- 8.3 Rib Lacing cord
- 8.4 Special fasteners
- 8.5 Surface tape

A T 268 FUNDAMENTALS OF AIRCRAFT WELDING, COVERING AND FINISHING

9.0 Dopes and Doping Processes
  9.1 General and terminology
  9.2 Doping processes
  9.3 Techniques of application
  9.4 Doping problems

10.0 Applying Fabric Covering
  10.1 General
  10.2 Material selection
  10.3 Aircraft structure preparation
  10.4 Dope proofing
  10.5 Chafe points
  10.6 Inter-rib lacing
  10.7 Plywood preparation
  10.8 Covering methods and practices
  10.9 Fabric seams
  10.10 Reinforcing tape
  10.11 Ribstitching
  10.12 Surface tape

11.0 Seams
  11.1 Sewn seams
  11.2 Doped seams

12.0 Wing Covering
  12.1 General and terminology
  12.2 Covering methods
  12.3 Rib stitching
  12.4 Alternate fabric attachment methods
  12.5 Anti-tear strips and surface tape

13.0 Fuselage Covering
  13.1 General
  13.2 Fuselage lacing
  13.3 Tightening fabric, compound curves

14.0 Drain and Inspection Openings
  14.1 General
  14.2 Ventilation and drain grommets
  14.3 Inspection openings
  14.4 Inspection procedures

15.0 Fabric and Dope Deterioration
  15.1 General
  15.2 Mildew
  15.3 Sunlight
  15.4 Dope acidity
  15.5 Dope contamination
  15.6 Storage conditions

A T 268 FUNDAMENTALS OF AIRCRAFT WELDING, COVERING AND FINISHING

16.0 Fabric Repairs
    16.1 General
    16.2 Damage, (tears)
    16.3 Sewed patch repair
    16.4 Doped patch repair
    16.5 Panel repair

17.0 Painting Systems
    17.1 General
    17.2 History and economics of major systems
    17.3 Purpose and paint application of major systems

18.0 Paint Stripping
    18.1 Purpose of stripping
    18.2 Types of strippers
    18.3 Application of stripper
    18.4 Cleaning procedures

19.0 Metal Conditioners
    19.1 Purpose of metal etching
    19.2 Types of conditioners
    19.3 Applying metal conditioners
    19.4 Shop safety precautions

20.0 Primers
    20.1 Purpose of primers
    20.2 Surface preparation
    20.3 Types of primers
    20.4 Applying Primers
    20.5 Contamination prevention

21.0 Topcoats
    21.1 General
    21.2 Major topcoat systems
    21.3 Applying topcoats
    21.4 Waxing and cleaning

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 - 3.0 WELDING

Instructional Goal Know welding terminology, general applications of welding, the major types of welding processes and welding safety precautions.

Defined Outcome Students will define welding terms, describe the major applications of welding and processes. Students will demonstrate and describe safety precautions associated with a welding shop.

Instructional Goal Know the basics of oxygen-acetylene welding, temperatures of melting metal, and puddle formation.

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Defined Outcome Students will define the basics of oxygen-acetylene welding, demonstrate knowledge and skill of molten metal puddle manipulation and describe welding safety precautions.

Instructional Goal Know the aspects of an airworthy weld, how to fabricate an inner sleeve splice and a cluster joint.

Defined Outcome Students will demonstrate skill and knowledge in determining an airworthy weld, and describe the fabrication procedure for an inner sleeve splice and a cluster joint.

4.0 METAL CUTTING TORCH

Instructional Goal Know cutting torch equipment, its proper use in metal plate cutting, and safety precautions.

Defined Outcome Students will demonstrate skill and knowledge in plate steel cutting and shop safety precautions.

5.0 BRAZING

Instructional Goal Know brazing equipment, brazing procedures, puddle manipulation, and assess airworthiness of brazing.

Defined Outcome Students will demonstrate the use of brazing equipment, and show skill and knowledge in brazing procedures, and determine airworthiness of a brazed joint.

6.0 OTHER WELDING PROCESSES

Instructional Goal Be familiar with ARC and shielded arc welding, soldering and joining aluminum, stainless steel and magnesium.

Defined Outcome Students will describe arc and shielded arc welding and soldering and select the proper procedure for joining stainless steel, aluminum on a magnesium.

7.0 - 8.0 AIRCRAFT FABRICS

Instructional Goal Know fabric terminology, quality, and strength requirements and the two categories of fabric.

Defined Outcome Students will show how to determine fabric quality, strength, and type.

Instructional Goal Know the purpose of all the applicable miscellaneous fabric materials.

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Defined Outcome Students will define the purpose of those items considered miscellaneous fabric materials, and demonstrate their skill and knowledge in applying them to a fabric covered surface.

9.0 AIRCRAFT DOPE

Instructional Goal Know the terminology applicable to dopes, and dope processes, the techniques of applying dope and how to cure doping problems.

Defined Outcome Students will define dope terminology and processes. Students will demonstrate the correct technique in dope application and how to resolve dope application problems.

10.0 - 14.0 FABRIC APPLICATION

Instructional Goal Understand fabric selection, airframe preparation and dope proofing before fabric covering. Know basic covering methods for seams, reinforcing, and surface tapes and rib stitching.

Defined Outcome Students will describe how to determine type and grade of fabric for covering. Demonstrate skill in dope proofing, fabric covering, fabricating covering seams, installing reinforcing tape, rib stitching and surface tape following approved procedures.

Instructional Goal Recognize and understand, covering methods of fuselage and wings including rib stitching and the installation of inspection and drain fixtures.

Defined Outcome Students will demonstrate skill and knowledge in covering a surface in an airworthy manner up through the finish coat.

15.0 DOPE AND FABRIC DETERIORATION

Instructional Goal Know the effects on fabric of mildew, ultraviolet rays, dope acidity and contamination.

Defined Outcome Students will describe and identify fabric mildew, sunlight deterioration, dope contamination, and the approved methods of preventing these items.

16.0 FABRIC REPAIRS

Instructional Goal Know the difference between a major and a minor repair of fabric. Know how to perform a sewed or doped patch repair and a doped panel repair.

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Defined Outcome Students will show knowledge and skill in performing a minor doped repair and describe how to make a sewn minor repair, and a panel repair.

17.0 PAINTING SYSTEMS

Instructional Goal Recognize, and understand the primary purpose of painting systems and how they are applied. Know the historical, and economical aspects of the major painting systems.

Defined Outcome Students will describe the advantages and disadvantages of the major painting systems and how they are applied.

18.0 - 19.0 STRIPPING AND CONDITIONING

Instructional Goal Know the purpose of stripping, the types, and application of strippers and cleaning procedures. Know metal conditioners, their purpose and how to apply them.

Defined Outcome Students will safely apply a stripper to a painted surface, clean the surface and apply a conditioner to prepare the surface for priming.

20.0 - 21.0 PRIMER AND TOPCOAT SYSTEMS

Instructional Goal Know the purpose of primer and topcoat systems, the major types of systems, how to apply primers and topcoats and prevent system contamination.

Defined Outcome Students will demonstrate knowledge and skill in the selection and application of a primer and a topcoat paint system.

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FAR 147 APPENDIX B (GENERAL)

ITEM	LEVEL	
18	3	Inspect and check welds.

APPENDIX C (AIRFRAME)

4	1	Select and apply fabric and fiberglass covering materials.
5	3	Inspect, test, and repair fabric and fiberglass.
6	1	Apply trim letters and touchup paint.
7	2	Identify and select aircraft finishing materials.
8	2	Apply paint and dope.
9	2	Inspect finishes and identify defects.
17	1	Weld magnesium and titanium.
18	1	Solder stainless steel.
19	1	Fabricate tubular structures.
20	2	Solder, braze, gas weld and arc weld steel.
21	2	Weld aluminum and stainless steel.

COURSE CONTENT GUIDE

I. COURSE DESIGN

a. Overview: Beginning with historical background, the student will be exposed to the theory of and techniques used in the tubular steel structures, aircraft dope and fabric procedures and paint systems.

b. Credits: Students will receive 2 credits for successful completion of this course.

c. Hours: This course is scheduled to meet 5 hours per week for fifteen weeks each semester (4500 min.) in class. In addition (900 min.) of outside work is expected for total student involvement of (5400 min.).

d. The 72 hours of instruction accounts for two holidays and is devoted entirely to laboratory exercises.

e. This course is required for completion of the Associate of Applied Science degree or Certificate Program in Aviation Maintenance.

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f. Lab Fees: Lab fees for this course are outlined in appendix A.

g. This course, in conjunction with the AMT curriculum prepares an individual for entry level positions in the aviation maintenance field.

II. ACTIVITIES

Formal lecture and demonstrations in the accompanying lecture course precedes preplanned, structured lab exercises that allow the students to observe and practice the tasks necessary to build skill and confidence in performing the required maintenance functions in traditional aircraft structures. Field trips may be used to demonstrate heavy aircraft or complex systems that are not available at ACC.

III. PREREQUISITE KNOWLEDGE AND SKILLS

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a. Passing the following courses or their equivalent with a grade of "C" or better:

A T 160 Aircraft Information, Regulations and Procedures

b. Demonstrating equivalent knowledge to the instructor's satisfaction by means of oral or written exam, academic record or work history.

c. This course must be taken concurrently with AT 268L Fundamentals of Aircraft Welding, Covering and Finishing.

IV. EVALUATION

a. Class attendance is mandatory. Effects of absences and methods for makeup are outlined in Appendix B.

b. Class performance will be evaluated by written or oral examinations.

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A T 268L FUNDAMENTALS OF AIRCRAFT WELDING, COVERING AND FINISHING LAB

V. COURSE OUTLINE

- 1.0 Welding
  - 1.1 General terminology
  - 1.2 Types of welding processes
  - 1.3 Safety procedures
  - 1.4 Equipment and facilities
  - 1.5 Materials required

- 2.0 Oxygen-Acetylene Welding without Filler Rod
  - 2.1 Procedure use of equipment
  - 2.2 Safety precautions
  - 2.3 Welding basics
  - 2.4 Temperatures of molten metal
  - 2.5 Puddle formation and penetration

- 3.0 Oxygen-Acetylene Welding with Filler Rod
  - 3.1 Welding procedures
  - 3.2 Weld bead formation and penetration and inspection.
  - 3.3 Determining airworthiness welds
  - 3.4 Inside sleeve splice
  - 3.5 Fabrication procedures for cluster welding

- 4.0 Oxygen-Acetylene Cutting
  - 4.1 Equipment and safety precautions
  - 4.2 Torch cutting use
  - 4.3 Metal cutting procedure
  - 4.4 Plate cutting

- 5.0 Brazing
  - 5.1 Equipment and components
  - 5.2 Procedures and applications
  - 5.3 Puddle manipulation
  - 5.4 Determining airworthiness

- 6.0 Other Welding Processes
  - 6.1 ARC
  - 6.2 Shielded ARC
  - 6.3 Soldering
  - 6.4 Magnesium, aluminum, stainless steel

- 7.0 Aircraft Fabrics
  - 7.1 Terminology
  - 7.2 Quality and strength requirements
  - 7.3 Natural fiber
  - 7.4 Synthetic
  - 7.5 Testing

- 8.0 Miscellaneous Fabric Materials
  - 8.1 Reinforcing tape
  - 8.2 Sewing thread
  - 8.3 Rib Lacing cord
  - 8.4 Special fasteners
  - 8.5 Surface tape

A T 268L FUNDAMENTALS OF AIRCRAFT WELDING, COVERING AND FINISHING LAB

9.0 Dopes and Doping Processes
  9.1 General and terminology
  9.2 Doping processes
  9.3 Techniques of application
  9.4 Doping problems

10.0 Applying Fabric Covering
  10.1 General
  10.2 Material selection
  10.3 Aircraft structure preparation
  10.4 Dope proofing
  10.5 Chafe points
  10.6 Inter-rib lacing
  10.7 Plywood preparation
  10.8 Covering methods and practices
  10.9 Fabric seams
  10.10 Reinforcing tape
  10.11 Ribstitching
  10.12 Surface tape

11.0 Seams
  11.1 Sewn seams
  11.2 Doped seams

12.0 Wing Covering
  12.1 General and terminology
  12.2 Covering methods
  12.3 Rib stitching
  12.4 Alternate fabric attachment methods
  12.5 Anti-tear strips and surface tape

13.0 Fuselage Covering
  13.1 General
  13.2 Fuselage lacing
  13.3 Tightening fabric, compound curves

14.0 Drain and Inspection Openings
  14.1 General
  14.2 Ventilation and drain grommets
  14.3 Inspection openings
  14.4 Inspection procedures

15.0 Fabric and Dope Deterioration
  15.1 General
  15.2 Mildew
  15.3 Sunlight
  15.4 Dope acidity
  15.5 Dope contamination
  15.6 Storage conditions

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A T 268L FUNDAMENTALS OF AIRCRAFT WELDING, COVERING AND FINISHING LAB

- 16.0 Fabric Repairs
  - 16.1 General
  - 16.2 Damage, (tears)
  - 16.3 Sewed patch repair
  - 16.4 Doped patch repair
  - 16.5 Panel repair

- 17.0 Painting Systems
  - 17.1 General
  - 17.2 History and economics of major systems
  - 17.3 Purpose and paint application of major systems

- 18.0 Paint Stripping
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- 19.0 Metal Conditioners
  - 19.1 Purpose of metal etching
  - 19.2 Types of conditioners
  - 19.3 Applying metal conditioners
  - 19.4 Shop safety precautions

- 20.0 Primers
  - 20.1 Purpose of primers
  - 20.2 Surface preparation
  - 20.3 Types of primers
  - 20.4 Applying primers
  - 20.5 Contamination prevention

- 21.0 Topcoats
  - 21.1 General
  - 21.2 Major topcoat systems
  - 21.3 Applying topcoats
  - 21.4 Waxing and cleaning

VI. INSTRUCTIONAL GOALS AND DEFINED OUTCOMES

1.0 - 3.0 WELDING

Instructional Goal Know welding terminology, general applications of welding, the major types of welding processes and welding safety precautions.

Defined Outcome Students will define welding terms, describe the major applications of welding and processes. Students will demonstrate and describe safety precautions associated with a welding shop.

Instructional Goal Know the basics of oxygen-acetylene welding, temperatures of melting metal, and puddle formation.

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Defined Outcome Students will define the basics of oxygen-acetylene welding, demonstrate knowledge and skill of molten metal puddle manipulation and describe welding safety precautions.

Instructional Goal Know the aspects of an airworthy weld, how to fabricate an inner sleeve splice and a cluster joint.

Defined Outcome Students will demonstrate skill and knowledge in determining an airworthy weld, and describe the fabrication procedure for an inner sleeve splice and a cluster joint.

4.0 METAL CUTTING TORCH

Instructional Goal Know cutting torch equipment, its proper use in metal plate cutting, and safety precautions.

Defined Outcome Students will demonstrate skill and knowledge in plate steel cutting and shop safety precautions.

5.0 BRAZING

Instructional Goal Know brazing equipment, brazing procedures, puddle manipulation, and assess airworthiness of brazing.

Defined Outcome Students will demonstrate the use of brazing equipment, and show skill and knowledge in brazing procedures, and determine airworthiness of a brazed joint.

6.0 OTHER WELDING PROCESSES

Instructional Goal Be familiar with ARC and shielded arc welding, soldering and joining aluminum, stainless steel and magnesium.

Defined Outcome Students will describe arc and shielded arc welding and soldering and select the proper procedure for joining stainless steel, aluminum on a magnesium.

7.0 - 8.0 AIRCRAFT FABRICS

Instructional Goal Know fabric terminology, quality, and strength requirements and the two categories of fabric.

Defined Outcome Students will show how to determine fabric quality, strength, and type.

Instructional Goal Know the purpose of all the applicable miscellaneous fabric materials.

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Defined Outcome Students will define the purpose of those items considered miscellaneous fabric materials, and demonstrate their skill and knowledge in applying them to a fabric covered surface.

9.0 AIRCRAFT DOPE

Instructional Goal Know the terminology applicable to dopes, and dope processes, the techniques of applying dope and how to cure doping problems.

Defined Outcome Students will define dope terminology and processes. Students will demonstrate the correct technique in dope application and how to resolve dope application problems.

10.0 - 14.0 FABRIC APPLICATION

Instructional Goal Understand fabric selection, airframe preparation and dope proofing before fabric covering. Know basic covering methods for seams, reinforcing, and surface tapes and rib stitching.

Defined Outcome Students will describe how to determine type and grade of fabric for covering. Demonstrate skill in dope proofing, fabric covering, fabricating covering seams, installing reinforcing tape, rib stitching and surface tape following approved procedures.

Instructional Goal Recognize and understand, covering methods of fuselage and wings including rib stitching and the installation of inspection and drain fixtures.

Defined Outcome Students will demonstrate skill and knowledge in covering a surface in an airworthy manner up through the finish coat.

15.0 DOPE AND FABRIC DETERIORATION

Instructional Goal Know the effects on fabric of mildew, ultraviolet rays, dope acidity and contamination.

Defined Outcome Students will describe and identify fabric mildew, sunlight deterioration, dope contamination, and the approved methods of preventing these items.

16.0 FABRIC REPAIRS

Instructional Goal Know the difference between a major and a minor repair of fabric. Know how to perform a sewed or doped patch repair and a doped panel repair.

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Defined Outcome Students will show knowledge and skill in performing a minor doped repair and describe how to make a sewn minor repair, and a panel repair.

17.0 PAINTING SYSTEMS

Instructional Goal Recognize, and understand the primary purpose of painting systems and how they are applied. Know the historical, and economical aspects of the major painting systems.

Defined Outcome Students will describe the advantages and disadvantages of the major painting systems and how they are applied.

18.0 - 19.0 STRIPPING AND CONDITIONING

Instructional Goal Know the purpose of stripping, the types, and application of strippers and cleaning procedures. Know metal conditioners, their purpose and how to apply them.

Defined Outcome Students will safely apply a stripper to a painted surface, clean the surface and apply a conditioner to prepare the surface for priming.

20.0 - 21.0 PRIMER AND TOPCOAT SYSTEMS

Instructional Goal Know the purpose of primer and topcoat systems, the major types of systems, how to apply primers and topcoats and prevent system contamination.

Defined Outcome Students will demonstrate knowledge and skill in the selection and application of a primer and a topcoat paint system.

VII. PROJECTS

FAA Level

1.0 Welding
- 1.1 Puddle manipulation without filler rod (6" wide plate)
- 2 1.2 Puddle manipulation with filler rod (6" wide plate)
- 1.3 Weld overlapp joining. (6" wide plate)
- 1.4 Braze overlapp joining (6" wide plate)
- 1.5 Assess airworthiness of weld (inner sleeve splice and cluster weld).
- 1.6 Oxygen-Acetylene cutting torch , cut plate.
- 1.7 Inspection and testing (destructive and non-destructive) of welds and welded structures.

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2.0 Dope and Fabric
    2.1 Surface
2   a. Dope proof
            b. Fabric application
            c. Tensioning
            d. Dope application
            e. Drain grommet and inspection ring applications
            f. Rib stitch
            g. Surface tape application
            h. Silver and color application
    2.2 Fabric repair: doped on for 6" tear
            a. Finish determination and preparation
            b. Patch application
            c. Tensioning
            d. Dope application
            e. Surface tape application
            f. Finish
3   2.3 Inspect fabric cover

3.0 Painting
    3.1 Aircraft panel (approx. 10 sq.ft.)
2   a. Strip paint
            b. Metal etch panel (condition)
            c. Prime panel (undercoat)
            d. Apply topcoat (finish)